The American Midland Naturalist

Devoted to Natural History, Primarily that of the Prairie States

Founded by J. A. Nieuwland, C.S.C.

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The Flora of Crater Lake National Park

F. Lyle Wynd

The present work is based on many seasons of field work in Crater Lake National Park. With the exception of three instances, the species listed have been collected by the author. Individual specimens are not cited since the author's Crater Lake material has been deposited in the Herbarium of the University of Oregon, where it is easily available to future students.

The synonymy is limited to the names occurring in thirty-one of the most important published Floras of the western states. References are made in chronological order to these Floras by the following code numbers enclosed by parentheses after the citation of the original publication of the name:

1. Howell, Thomas. A Flora of Northwest America, Portland, Oregon, 1897.

2. Rydberg, Per Axel. Catalogue of the Flora of Montana and the Yellowstone National Park. Mem. New York Botanical Garden, Vol. 1. 1900.

3. Sargent, Charles Sprague. Manual of the Trees of North America. Houghton, Mifflin Co. 1905.

4. Henshaw, Julie W. Mountain Wild Flowers of America. Ginn & Co. 1906.

5. Piper, Charles V. Flora of the State of Washington, Contrib. U. S. National Herbarium. Vol. 2. 1906.

6. Brown, Stewardson and Mrs. Charles Schäffer. Alpine Flora of the Canadian Rocky Mountains. Putnam's Sons. 1907.

7. Sweetser, Albert R. and Mary E. Kent. Key and Flora; Some of the Common Flowers of Oregon. Ginn. & Co. 1908.

8. Coulter, John M. and Aven Nelson. New Manual of Botany of the Central Rocky Mountains. American Book Co. 1909.

9. Jepson, Willis Linn. The Trees of California, Univ. of California. 1909.

10. Jepson, Willis Linn. A Flora of Western Middle California. Ed. 2. University of California 1911.

11. Hall, Harvey Monroe and Carlotta Case Hall. A yosemite Flora. Paul Elder & Co., San Francisco. 1912.

12. Frye, Theodore C. and George B. Rigg. Elementary Flora of the Northwest. American Book Co. 1914.

13. Piper, Charles V. and R. Kent Beattie. Flora of Southeastern Washington and Adjacent Idaho. Oregon State College. 1914.

14. Armstrong, Margaret. Western Wild Flowers. Putman's Sons. 1915.

15. Henry, Joseph Kaye. Flora of Southern British Columbia and Vancouver Island. W. J. Gage, Toronto. 1915.

16. Piper, Charles V. and R. Kent Beattie. Flora of the Northwest Coast. Univ. of Washington. 1915.

17. Wooton, E. O. and Paul C. Standley. Flora of New Mexico. Contrib. U. S. National Herbarium, Vol. 19. 1915.

18. Parsons, Mary Elizabeth. The Wild Flowers of California. Cunningham, Curtis and Welch, San Francisco. 1916.

19. Abrams, LeRoy. Flora of Los Angeles and Vincinity. Stanford University. 1917.

20. Rydberg, Per Axel. Flora of the Rocky Mountains and Adjacent Plains. N. Y. Botanical Garden. 1917.

21. Smiley, Frank Jason. A Report upon the Boreal Flora of the Sierra Nevada of California. University of California, Publications in Botany. Vol. 9. 1921.

22. Standley, Paul C. Flora of Glacier National Park, Montana. Contrib. U. S. National Herbarium. Vol. 22, part 5. 1921.

23. Abrams, LeRoy. An Illustrated Flora of the Pacific States. Stanford University 1923.

24. Davidson, Anstruther and George L. Moxley. Flora of Southern California. Los Angeles. 1923.

25. Jepson, Willis Linn. A Manual of the Flowering Plants of California. University of California. 1925.

26. Tidestrom, Ivar. Flora of Utah and Nevada. Contrib. U. S. National Herbarium. Vol. 25. 1925.

27. Garrett, A. O. Spring Flora of the Wasatch Region. 1927.

28. Clements, Edith S. Flowers of Coast and Sierra. Wilson Co., N. Y. 1928.

29. Gilkey, Helen M. A Spring Flora of Northwestern Oregon. Oregon State College. 1929.

30. Benson, Gilbert Thereon. The Trees and Shrubs of Western Oregon. Stanford University. 1930.

31. Rydberg, Per Axel. Flora of the Prairies and Plains of Central North America. N. Y. Botanical Garden. 1932.

Since specimens are rarely cited in Floras, it is frequently impossible to know how certain species have been treated by various authors. The mere fact that a name appears does not prove that the same species is described, and hence occasional erroneous references are unavoidable.

The author wishes to express his appreciation to the many persons who have aided him in carrying his work to completion. Generous grants of funds by the University of Oregon Chapter of the Sigma Xi, and the purchase of the collections by the Department of Botany of the University of Oregon made the extensive field work possible. The deepest personal appreciation is due to Professor L. F. Henderson, Curator of the University of Oregon Herbarium, for his cooperation in the determination of specimens, and to Dr. E. L. Packard, Oregon State College, for personal encouragement and for cooperation in making available the funds mentioned above. The following specialists have generously studied the author's specimens of their respective groups. Kenneth K. Mackenzie determined some of the sedges; A. S. Hitchcock and Agnes Chase, many of the grasses; Frederick V. Coville, the Juncaceae; Carleton R. Ball, the willows; Charles Piper Smith, the lupines; and LeRoy Abrams, most of the specimens of *Arabis*. Dr. Mildred Mathias of the New York Botanical Garden kindly read the section on the Umbelliferae, and Dr. J. M. Greenman of the Missouri Botanical Garden has given valuable assistance on problems of nomenclature. A large number of people has furnished information by letters, a mere list of which would require

several pages; consequently it is only possible to thank those contributors collectively.

The author invites correspondence from those interested in the flora of Crater Lake National Park, and will gladly determine specimens from the Park area.

KEYS TO THE FAMILIES

Plants reproducing by spores. See Phylum 1. PTERIDOPHYTA.
Plants reproducing by seeds. See Phylum 2. SPERMATOPHYTA.

Phylum 1. PTERIDOPHYTA

Leaves few, large. Stems mostly underground.
Spore cases in the tissue of a prominent and distinct fertile lobe of the leaf. ---------- *Ophioglossaceae.*
Spore cases formed of outgrowths from the surface of the leaf. ---*Polypodiaceae.*
Leaves numerous, small. Stems aerial and underground.----------*Equisetaceae.*

Phylum 2. SPERMATOPHYTA

Ovules and seeds not in a closed cavity, usually on the face of an open scale-leaf.
Stigmas none.----------See *Gymnospermae.*
Ovules and seeds contained in a closed cavity or ovary. Stigmas present.
Leaves usually parallel-veined. Parts of the flower nearly always in threes.
Cotyledon one. ----------See *Monocotyledoneae.*
Leaves usually net-veined. Parts of the flower in fours, fives, or sixes, never in threes. Cotyledons two. ----------See *Dicotyledoneae.*

GYMNOSPERMAE

Fruit a single stone, enclosed or subtended by a fleshy integument. ---------*Taxaceae.*
Fruit a cone with several ovule-bearing woody scales (coalescent and berry-like in *Juniperus*).
Leaves and floral parts spirally arranged. ----------*Pinaceae.*
Leaves and floral parts arranged in cycles of 2 or 3.----------*Cupressaceae.*

MONOCOTYLEDONEAE

Perianth none, or of bristles, chaffy scales, or a hyaline envelope.
Stems mostly hollow and jointed. Leaves 2-ranked. ----------*Gramineae.*
Stems solid. Leaves 3-ranked. ----------*Cyperaceae.*
Perianth present, the parts glume-like or petal-like.
Perianth of glume-like segments. ----------*Juncaceae.*
Perianth at least in part petal-like.
Ovary superior. Flowers regular or nearly so. ----------*Liliaceae.*
Ovary inferior. Flowers regular or irregular.
Flowers regular. ----------*Iridaceae.*
Flowers irregular. ----------*Orchidaceae.*

DICOTYLEDONEAE

Petals distinct to the base or wanting.
Petals none. ----------See Section I
Petals present.
Stamens numerous, at least more than 10, and more than twice the number of sepals or calyx lobes. ----------See Section II
Stamens not more than twice as many as the petals. ---------See Section III
Petals more or less united into one piece. ----------See Section IV

Section I

Plants parasitic or saphrophytic and usually without chlorophyll.
- Flowers dioecious. Stamens 2-6. ——— *Loranthaceae.*
- Flowers perfect. Stamens 10. ——— *Allotropa.*

Plants neither parasitic nor saphrophytic, and having chlorophyll.
- Trees or shrubs.
  - Leaves opposite. ——— *Aceraceae.*
  - Leaves alternate.
    - Flowers not in aments. ——— *Rhamnus.*
    - Flowers, or some of them, in aments.
      - Staminate flowers in aments, the pistillate flowers 1-3 in a cluster. ——— *Fagaceae.*
      - Staminate and pistillate flowers both in aments.
        - Ovary 1-celled, many-ovuled. Calyx not present. ——— *Salicaceae.*
        - Ovary 1-2-celled, each cell 1-ovuled. ——— *Betulaceae.*
- Herbs, sometimes woody at base.
  - Leaves opposite, never whorled. ——— *Caryophyllaceae.*
  - Leaves not opposite, rarely whorled.
    - Flowers monoecious. ——— *Chenopodiaceae.*
    - Flowers perfect or dioecious.
      - Pistils more than 1.
        - Stamens perigynous. ——— *Rosaceae.*
        - Stamens hypogynous. ——— *Ranunculaceae.*
      - Pistils 1.
        - Anthers opening by uplifted valves. ——— *Achlys.*
        - Anthers not opening by uplifted valves.
          - Ovary 2-celled. ——— *Cruciferae.*
          - Ovary 1-celled.
            - Fruit an achene.
              - Achene enclosed in the receptacle. ——— *Rosaceae.*
              - Achene not enclosed in the receptacle. ——— *Polygonaceae.*
            - Fruit not an achene.
              - Fruit a utricle. ——— *Chenopodiaceae.*
              - Fruit a capsule. ——— *Claytonia.*

Section II

Calyx free and separate from the ovary.
- Pistils more than 1.
  - Ovaries cohering in a ring around a central axis. ——— *Malvaceae.*
  - Ovaries separate, or if united not cohering in a ring around a central axis.
    - Stamens perigynous. ——— *Rosaceae.*
    - Stamens hypogynous. ——— *Ranunculaceae.*
- Pistils only one, with one to several styles and stigmas.
  - Leaves minutely punctate with pellucid dots. ——— *Hypericaceae.*
  - Leaves not punctate with pellucid dots.
    - Ovary simple.
      - Stamens hypogynous. ——— *Ranunculaceae.*
      - Stamens perigynous. ——— *Rosaceae.*
    - Ovary compound, 1-celled, with a central placenta. ——— *Portulacaceae.*

Calyx more or less coherent with the surface of the compound ovary.
Ovary more than 1-celled. ---------- *Rosaceae.*
Ovary 1-celled. Placenta basal. ---------- *Portulacaceae.*

Section III

Stamens opposite the petals.
Ovary 2-4 celled. ---------- *Rhamnaceae.*
Ovary 1-celled.
Anthers opening by uplifted valves. ---------- *Berberidaceae.*
Anthers not opening by uplifted valves. ---------- *Portulacaceae.*
Stamens not opposite the petals.
Ovary at least half inferior.
Plants low, creeping or suberect shrubs. Leaves glutinous, having a pungent odor when crushed. ---------- *Ribes.*
Plants not as above in all points.
Ovules and seeds more than 1 in each cell of the ovary.
Leaves palmate. Shrubs. ---------- *Saxifragaceae.*
Leaves not palmate. ---------- *Onagraceae.*
Ovules and seeds only one in each cell of the ovary.
Petals 5. Flowers in umbels. ---------- *Umbelliferae.*
Petals 2-4. Flowers not in umbels. ---------- *Onagraceae.*
Ovary wholly superior.
Ovaries 2 or more.
Ovaries somewhat united at the base, separate above.
Trees. ---------- *Aceraceae.*
Herbs. ---------- *Saxifragaceae.*
Ovaries entirely separate.
Stamens hypogynous.
Carpels numerous. ---------- *Ranunculaceae.*
Carpels 4 or 5. ---------- *Crassulaceae.*
Stamens perigynous or epipetalous.
Stamens just twice as many as the pistils. ---------- *Crassulaceae.*
Stamens not just twice as many as the pistils.
Leaves without stipules. ---------- *Saxifragaceae.*
Leaves with stipules. ---------- *Rosaceae.*
Ovaries only 1.
Ovary simple, with 1 parietal placenta. ---------- *Leguminosae.*
Ovary compound, as shown by the number of cells, placentae, styles, or stigmas.
Ovary 1-celled.
Corolla irregular.
Stamens 6. Petals 4. ---------- *Fumariaceae.*
Stamens and petals 5. ---------- *Violaceae.*
Corolla regular or nearly so.
Ovule 1. ---------- *Cruciferae.*
Ovules more than 1.
Placenta central or basal. ---------- *Caryophyllaceae.*
Placentae parietal.
Leaves punctate with pellucid dots. *Hypericaceae.*
Leaves not punctate.
Leaves smooth and glabrous, or else plants not green. ---------- *Ericaceae.*

Leaves not glabrous.
Leaves bristly-grandular with long hairs which form insect traps. ---------- *Droseraceae.*
Leaves without bristly-glandular hairs. ---------- *Saxifragaceae.*
Ovary 2-several celled.
Stamens neither just as many nor twice as many as the petals.
Trees or shrubs. ---------- *Aceraceae.*
Herbs. Stamens 6 tetradynamous. ---------- *Cruciferae.*
Stamens either just as many or twice as many as the petals.
Ovules 1 or 2 in each cell of the ovary.
Leaves pinnately veined. ---------- *Celastraceae.*
Leaves palmately veined. Trees. ---------- *Aceraceae.*
Ovules several to many in each cell of the ovary.
Stamens on the calyx. ---------- *Saxifragaceae.*
Stamens free from the calyx.
Style 1. ---------- *Ericaceae.*
Styles 2-4. ---------- *Caryophyllaceae.*

Section IV

Stamens more numerous than the corolla lobes.
Ovary 1-celled.
White or reddish chlorophyll-less parasitic or saprophytic herbs. ---- *Ericaceae.*
Green chlorophyll-bearing herbs, not parasitic nor saprophytic.
Ovary with 1 parietal placenta. ---------- *Leguminosae.*
Ovary with 2 parietal placentae. ---------- *Fumariaceae.*
Ovary 3 to many-celled. Chlorophyll-bearing herbs, not parasitic nor saprophytic. ---------- *Ericaceae.*
Stamens as many as the corolla-lobes or fewer.
Stamens opposite the corolla-lobes. ---------- *Primulaceae.*
Stamens alternate with the corolla-lobes, or fewer.
Ovary inferior.
Flowers in an involucrate head on a common receptacle. ---- *Compositae.*
Flowers not in an involucrate head nor on a common receptacle.
Stamens on the ovary. ---------- *Campanulaceae.*
Stamens on the corolla.
Stamens 1-2. ---------- *Valerianaceae.*
Stamens 4-5.
Leaves opposite or whorled, when opposite with stipules. ---------- *Rubiaceae.*
Leaves opposite, without stipules. ---------- *Caprifoliaceae.*
Ovary superior.
Corolla more or less irregular.
Ovules solitary in the cells of the ovary. ---------- *Labiatae.*
Ovules 2 or more, usually numerous in each cell of the ovary.
Ovary and pod 2-celled. Plants with chlorophyll. ---------- *Scrophulariaceae.*
Ovary and pod 1-celled. Plants without chloryhyll. ---------- *Orobanchaceae.*
Corolla regular.
Stamens fewer than the corolla-lobes. ---------- *Veronica.*
Stamens as many as the corolla-lobes.
Ovaries 2, separate. ---------- *Apocynaceae.*
Ovary 1.
Ovary deeply 4-lobed around the style. ---- *Boraginaceae.*

Ovary not deeply lobed.
Ovary 1-celled.
Leaves entire, opposite. ——— *Gentianaceae.*
Leaves alternate or basal, rarely entire.
——— *Hydrophyllaceae.*
Ovary 2 or more celled.
Stamens free from the corolla. ——— *Ericaceae.*
Stamens on the corolla-tube.
Fruit a many-seeded pod or berry.
Flowers white, (in ours.) ——— *Solanaceae.*
Fruit a few-seeded pod. Flowers not white, (in ours). ——— *Polemoniaceae.*

POLYPODIACEAE. Fern Family

Sori dorsal upon the veins, separate, not marginal.
Indusium, when present, inferior, attached by its base on one side. 1. *Cystopteris.*
Indusium, when present, superior.
Sori round. Indusium centrally peltate. ——— 2. *Polystichum.*
Sori mostly lunate, at least not round. ——— 3. *Athyrium.*
Sori marginal or submarginal.
Fertile and sterile fronds unlike. ——— 4. *Cryptogramma.*
Fertile and sterile fronds alike or nearly so.
Plants large, usually over 1 foot high. Fronds borne singly, never in tufts. ——— 5. *Pteridium.*
Plants small, never over 1 foot high. Fronds in tufts.
Fronds hairy below. ——— 6. *Cheilanthes.*
Fronds glabrous below. ——— 7. *Pellaea.*

1. *Cystopteris* Bernh.

1. *Cystopteris fragilis* (L.) Bernh., Schrad. Neues Jour. Bot. 1: 27. pl. 2, f. 9. 1806; (2, 11, 15, 21).

Filix fragilis (L.) Gilib., Exerc. Phyt. 558. 1792; (5, 6, 8, 13, 16, 17, 22, 23, 24, 26, 31).

2. *Polystichum* Roth

Pinnae, at least the lower ones, pinnate. ——— 1. *P. scopulinum.*
Pinnae never pinnate.
Lowest pinnae deltoid. ——— 2. *P. lonchitis.*
Lowest pinnae not deltoid. ——— 3. *P. munitum* var.

1. *Polystichum scopulinum* (D. C. Eaton) Maxon, Fern Bull. 8: 29. 1900; (5, 15, 23, 24, 25, 26).

2. *Polystichum lonchitis* (L.) Roth, Röm. Arch. Bot. 2: 106. 1799; (2, 5, 6, 8, 15, 21, 22, 23, 25, 26, 31).

3. *Polystichum munitum* (Kaulf.) Presl, var. *imbricans* (D. C. Eaton) Maxon, Fern Bull. 8: 30. 1900; (5, 11, 15, 23, 25).

3. *Athyrium* Roth

1. *Athyrium Filix-femina* (L.) Roth, Röm. Arch. Bot. 2: 106. 1799; (17, 22, 23, 26).

Asplenium Filix-femina (L.) Bernh., Schrad. Neues Jour. Bot. 1:26. 1806; (2, 6, 8, 11).

Athyrium cyclosorum Rupr., Beitr. Pflanzenk. Russ. Reich. 3:41. 1845; (13, 16).

Asplenium cyclosorum Rupr., Distr. Crypt. Vasc. Ross. 41. 1845; (15).

Asplenium Filix-femina (L.) Bernh. var. *cyclosorum* Rupr., in Rothrock, U. S. Geog. Surv. W. 100th Merid. 6: 331. 1879; (21).

Athyrium Filix-femina (L.) Roth, var. *californicum* Butters, Rhodora 19:201. 1918; (24, 25).

Athyrium angustum (Willd.) Presl. Rel. Haenk. 1:39. 1825; (31).

4. *Cryptogramma* R. Br.

1. *Cryptogramma acrostichoides* R. Br., in Richards., Bot. App. in Franklin's Narr. Jour. Shores Polar Sea 367. 1823; (2, 6, 8, 11, 15, 16, 21, 22, 23, 24, 25, 26, 31).

5. *Pteridium* Scop.

1. *Pteridium aquilinum* (L.) Kuhn, var. *pubescens* Under., Nat. Ferns ed. 6, 91. 1900; (5, 6, 13, 16, 17, 22, 23, 24, 26).

Pteris aquilina L. var. *lanuginosa* Bong., Mem. Acad. St. Petersb. VI. 2: 176. 1832; (11, 15, 25).

6. *Cheilanthes* Swartz

1. *Cheilanthes gracillima* Eaton, in Torr., Bot. Mex. Bound. 234. 1859; (2, 11, 13, 15, 21, 22, 23, 25, 26).

7. *Pellaea* Link

Pellaea densa Hook., Sp. Fil. 2: 150. pl. 125. B. 1858; (2, 5, 11, 21, 25).

Cryptogramma densa (Hook.) Deils, in Engl. & Prantl, Pflan. Fam. 1(4):280. 1899; (31).

Cheilanthes siliquosa Maxon, Am. Fern Jour. 8:116. 1918; (23).

OPHIOGLOSSACEAE. Adder's Tongue Family

1. *Botrychium* Sw.

Botrychium pumicola Coville, in Underw. Nat. Ferns, ed. 6. 69. 1900: (23).

This plant is known only from Crater Lake. It grows on the dry pumice slopes of the higher portions of the Rim.

EQUISETACEAE. Horsetail Family

1. *Equisetum* L.

Stems perennial. Spikes mucronate at the summit, fruiting in summer. 1. *E. hyemale* var.
Stems annual. Spikes not mucronate at the summit, fruiting in the spring. 2. *E. arvense.*

1. *Equisetum hyemale* L. var. *robustum* (A. Br.) A. A. Eaton., Fern Bull. 11: 112. 1903; (13, 25).

Equisetum praealtum Raf., Fl. Ludovic. 13. 1817; (23).

Equisetum robustum A. Br., Am. Jour. Sci. 46:88. 1843; (2, 17, 31).

2. *Equisetum arvense* L., Sp. Pl. 1061. 1753; (2, 5, 6, 8, 13, 15, 16, 17, 21, 22, 23, 24, 26, 31).

TAXACEAE. Yew Family

1. *Taxus* L.

1. *Taxus brevifolia* Nutt., N. Am. Sylva 3: 86, pl. 108. 1849; (1, 2, 3 5, 6, 7, 9, 10, 11, 12, 13, 16, 20, 22, 23, 25, 30).

CUPRESSACEAE. Cypress Family

Cone modified into a fleshly, drupe-like fruit. Dwarf trees. ----------1. *Juniperus.*
Cone composed of dry scales. Tall trees.
  Cone-scales 8-12, rather thin, imbricate. ----------2. *Thuja.*
  Cone-scales 6, thick, valvate. ----------3. *Libocedrus*

1. *Juniperus* (Tourn.) L.

1. *Juniperus sibirica* Burgsd., Anleit. Holz. 273. 1787; (2, 6, 7, 16, 17, 20, 22, 23, 26, 30, 31).

Juniperus communis L. var. *montana* Ait., Hort. Kew 3:414. 1788; (21, 25).

Juniperus nana Willd., Sp. Pl. 4:854. 1806; (1).

Juniperus communis L. var. *sibirica* (Burgsd.) Rydb., Contrib. U. S. Nat. Herb. 3:533. 1896; (3, 5, 8, 15).

2. *Thuja* L.

1. *Thuja plicata* D. Don, Hort. Cantab. ed. 6, 249. 1811; (1, 2, 3, 5, 6, 7, 9, 12, 13, 15, 16, 20, 22, 23, 25, 30).

3. *Libocedrus* Endl.

1. *Libocedrus decurrens* Torr., Smiths. Contrib. 6: 7. 1854; (1, 3, 7, 9, 11, 12, 16, 19, 23, 24, 25, 26, 30).

PINACEAE. Pine Family

Leaves enclosed at the base in a persistent or deciduous membraneous sh ath.
  Cones maturing the second or third year. ----------1. *Pinus.*
Leaves not enclosed at the base in a membraneous sheath.
  Cones erect. ----------2. *Abies.*
  Cones pendulous.
    Branchlets not roughened by persistent leaf-bases. Bracts of the cone longer than the scales. Leaves pungent. ----------3. *Pseudotsuga.*
    Branchlets roughened by the persistent leaf-bases. Bracts of the cone shorter than the scales. Leaves not pungent.
      Leaves sessile on the woody stalk-like bases. ----------4. *Picea.*
      Leaves narrowed to a short petiole. ----------5. *Tsuga.*

1. *Pinus* (Tourn.) L.

Leaves less than 5 in a bunch.
  Leaves under 3 inches long, in groups of 2. ----------1. *P. contorta* var.
  Leaves over 3 inches long, mostly in groups of 3, rarely only 2.--2. *P. ponderosa.*
Leaves 5 in a bunch.
  Cones averaging under 6 inches long. ----------3. *P. albicaulis.*
  Cones averaging over 6 inches long.
    Cones 10 inches or less long. Seed wings acute. ----------4. *P. monticola.*
    Cones 10-20 inches long. Seed wing rounded at the apex. 5. *P. Lambertiana.*

1. *Pinus contorta* Loud. var. *Murrayana* (Balf.) Engelm. in Wats. Bot. Calif. 2: 126. 1880; (3, 15, 21, 22, 25).

Pinus Murrayana Balf. in Murray, Rep. Bot. Oregon Exp. t. 3. f. 2. 1853; (2, 6, 8, 9, 10, 11, 13, 19, 20, 21, 24, 26, 27, 31).

2. *Pinus ponderosa* Dougl., in Lawson, Agri. Man. 354. 1836; (1, 2, 3, 5, 7, 9, 10, 11, 12, 13, 15, 16, 19, 20, 22, 23, 24, 25, 26, 30).

3. *Pinus albicaulis* Engelm., Trans. St. Louis Acad. 2: 209. 1863; (1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 21, 22, 23, 25, 26, 27, 30).

Apinus albicaulis (Engelm.) Rydb., Bull. Torr. Bot. Club. 32:598. 1905; (20).

4. *Pinus monticola* Dougl. in Lambert, Desc. Gen. Pinus, ed. 2. 3: 27. 1837; (1, 2, 3, 5, 7, 9, 10, 11, 12, 13, 15, 16, 21, 22, 23, 25, 26, 30).

Strobus monticola (Dougl.) Rydb., Fl., Rocky Mts. 13. 1060. 1917; (20).

5. *Pinus Lambertiana* Dougl., Trans. Linn Soc. 15: 500. 1827; (1, 3, 7, 9, 10, 11, 16, 19, 23, 24, 25, 26, 30).

2. *Abies* (Tourn.) Hill.

Leaves dark green above, with stomata only on the silvery white surface.
Bracts concealed by the scales. ——— 1. *A. amabilis.*

Leaves blue-green, with stomata on all sides. Bracts concealed or not concealed by the scales.
Bracts conspicuously exserted. Leaves 4-sided.
Bracts strongly recurved, having a long tapering apex. ——— 2. *A. nobilis.*
Bracts exserted as above, but not as strongly recurved, having an abruptly tapering apex. ——— 3. *A. magnifica* var.
Bracts scarcely half the length of the scales. Leaves flat.
Resinducts sunken in the leaf tissue (seen in cross section.) Bracts long-pointed. Crown conspicuously narrow and spire-like. ——— 4. *A. lasiocarpa.*
Resinducts next the epidermis. Bracts abruptly short-pointed. Crown not as above. ——— 5. *A. concolor.*

1. *Abies amabilis* (Dougl.) Forbes., Pinetum, Wob. 125. pl. 144. 1839; (1, 2, 3, 5, 7, 12, 15, 16, 23, 30).

2. *Abies nobilis* Lindl. in Penny Cyclop. 1: 30. 1833; (1, 3, 5, 7, 9, 12, 16, 30).

3. *Abies magnifica* Murr. var. *shastensis* Lemmon, Rep. Calif. State Board Forestry 3: 145. 1890; (3, 5, 11, 25, 30).

4. *Abies lasiocarpa* (Hook.) Nutt., N. Am. Sylva 3: 38. 1849; (1, 2, 3, 5, 6, 7, 8, 12, 13, 15, 16, 17, 20, 22, 23, 26, 27, 30).

5. *Abies concolor* Lindl., Jour. Hort. Soc. Lond. 5: 210. 1850; (1, 3, 7, 8, 9, 10, 11, 12, 16, 17, 19, 20, 21, 23, 24, 25, 27, 30).

3. *Pseudotsuga* Carr.

1. *Pseudotsuga mucronata* (Raf.) Sudw., Contri. U. S. Nat. Herb. 3: 266. 1895; (2, 3, 5, 6, 7, 8, 13, 15, 16, 17, 20, 22, 27, 30).

Pseudotsuga Douglasii Carr., Trait. Conif. ed. 2. 256. 1867; (1).
Pseudotsuga taxifolia Britt., Trans. N. Y. Acad. 8:74. 1889; (9, 10, 11, 12, 25).

4. *Picea* Link.

1. *Picea Engelmanni* Parry, in Engelm. Trans. St. Louis Acad. 2: 212.

1863; (1, 2, 3, 5, 6, 7, 8, 12, 13, 15, 16, 17, 22, 23, 25, 27, 30).

5. *Tsuga* Carr.

Cones ¾ inch long, at least never 1½ inches long. Young branchlets pubescent. ---------- 1. *T. heterophylla.*

Cones ⅔ inch long. Young branchlets not conspicuously pubescent. 2. *T. Mertensiana.*

1. *Tsuga heterophylla* (Raf.) Sarg., Silva N. Am. 12: 73. 1898; (1, 3, 5, 6, 7, 9, 10, 12, 15, 16, 20, 22, 23, 25, 30).

2. *Tsuga Mertensiana* (Bong.) Sarg., Silva N. Am. 12: 77. 1898; (1, 3, 5, 6, 7, 9, 10, 11, 12, 15, 16, 21, 23, 25, 30).

Hesperopeuce Mertensiana (Bong.) Rydb., Bull. Torr. Club 39:100. 1912; (20).

GRAMINEAE. Grass Family*

Spikelets sessile on a usually continuous rachis; the rachis disarticulating in *Sitanion* and in a few species of allied genera. Spikelets on opposite sides of the rachis. ---------- Tribe IV. *Hordeae.*

Spikelets pedicellate, in open or contracted (sometimes spike-like) panicles.
Spikelets 1-flowered. ---------- Tribe I. *Agrostideae.*
Spikelets 2- to many-flowered.
Glumes as long as the lowest floret, usually as long as the spikelet. Lemmas awned from the back. ---------- Tribe II. *Aveneae.*
Glumes shorter than the first floret. Lemmas awnless or awned from the tip (from a bifid apex in *Bromus.*) ---------- Tribe III. *Festuceae.*

Tribe I. *Agrostideae*

Rachilla articulate below the glumes, these falling with the spikelet. ---------- 1. *Cinna.*

Rachilla articulate above the glumes.
Fruit indurate, terete, awned, the nerves obscure. Callus usually well developed, oblique, bearded. ---------- 2. *Stipa*
Fruit thin or firm but scarcely indurate, if firm the nerves prominent or evident.
Callus not well developed.
Glumes longer than the lemma.
Glumes compressed-carinate, abruptly mucronate, stiffly ciliate on the keels. Panicle dense. ---------- 3. *Phleum.*
Glumes not compressed-carinate, not ciliate.
Florets with hairs at the base half as long as the lemma. Palea present. ---------- 4. *Calamagrostis.*
Florets naked at base or with short hairs. ---------- 5. *Agrostis.*
Glumes not longer than the lemma, usually shorter. ---------- 6. *Muhlenbergia.*

Tribe II. *Aveneae*

Lemmas keeled, bidentate, awned from above the middle. ---------- 7. *Trisetum.*
Lemmas convex, awned from below the middle. ---------- 8. *Aira.*

Tribe III. *Festuceae*

Palea winged. Spikelets linear, in a loose raceme. ---------- 9. *Pleuropogon.*
Palea not winged. Inflorescence mostly paniculate.
Lemmas keeled on the back.

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* Keys based on those of A. S. Hitchcock in Abrams, an Illustrated Flora of the Pacific States, and used by permission.

Spikelets strongly compressed, crowded in 1-sided clusters at the ends of the stiff naked panicle branches. ----------10. *Dactylis.*
Spikelets not strongly compressed, not in 1-sided clusters.
Lemmas awned from a bifed apex. Spikelets large. ------11. *Bromus.*
Lemmas awnless. Spikelets small. ----------12. *Poa.*
Lemmas rounded on the back.
Glumes papery. Lemmas firm, scarious margined. Upper florets sterile, often reduced to a club-shaped rudiment inclosed by the broad upper lemmas ---------- 13. *Melica.*
Glumes not papery. Upper florets not unlike the others.
Nerves of the lemma parallel, not converging at the summit or but slightly so. Lemmas awnless, mostly obtuse. ----------14. *Glyceria.*
Nerves of the lemma converging at the summit. Lemmas awned or pointed. ----------11. *Bromus.*

Tribe IV. *Hordeae*

Spikelets solitary at each joint of the rachis, occasionally 2 in Agropyron.
Spikelets placed edgewise to the rachis, the lateral ones with a single glume. ----------15. *Lolium.*
Spikelets placed flatwise to the rachis, all with 2 glumes.---------- 16. *Agropyron.*
Spikelets, at least some of them, in two or threes at each joint of the rachis.
Spikelets 1-flowered, not all alike, in threes, the lateral pair pedicelled. 17. *Hordeum.*
Spikelets 2-6 flowered, all alike, usually in twos.
Axis of spike continuous, not disarticulating at maturity, glumes broad or narrow, but not greatly elongate. ----------18. *Elymus.*
Axis of spike disarticulating at maturity. Glumes usually setaceous and elongate. ----------19. *Sitanion.*

1. *Cinna* L.

1. *Cinna latifolia* (Trevir.) Griseb. in Ledeb. Fl. Ross. 4: 435. 1853; (2, 5, 8, 13, 15, 16, 17, 20, 21, 22, 25, 31).

Cinna pendula Trin., Mem. Acad. St. Petersb. VI. Sci. Nat. 4 (1) :280. 1841; (1).

2. *Stipa* L.

Sheaths pubescent. ----------1. *S. Elmeri.*
Sheaths glabrous.
Blades involute, mostly basal. ----------2. *S. occidentalis.*
Blades flat, tardily involute, scattered. ----------3. *S. californica.*

1. *Stipa Elmeri* Piper & Brodie, U. S. Dept. Agr. Div. Agrost. Bull. 11: 46. 1898; (2, 5, 12, 13, 20, 23, 24, 25, 26).

2. *Stipa occidentalis* Thurb.; Wats. in King, Geol. Expl. 40th Par. 5: 380. 1871; (1, 5, 8, 12, 19, 21, 23, 24, 25, 26).

Stipa oregonensis Scribn., U. S. Dept. Agr. Div. Agrost. Bull. 17: 130. 8. 426. 1899; (20).

3. *Stipa californica* Merr. & Davy, Univ. Calif. Publ. Bot. 1: 61. 1902; (23, 24, 25, 26).

3. *Phleum* L.

Heads cylindrical, several times longer than wide. ----------1. *P. pratense.*
Heads ovoid or oblong, one and one half to two times as long as wide. 2. *P. alpinum.*

1. *Phleum pratense* L., Sp. Pl. 59. 1753; (1, 2, 5, 8, 10, 12, 13, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 31).

2. *Phleum alpinum* L., Sp. Pl. 59. 1753; (1, 2, 5, 8, 10, 12, 13, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 31).

4. *Calamagrostis* Adans.

1. *Calamagrostis canadensis* (Mich.) Beauv., Ess. Agrost. 15: 157. 1812; (1, 2, 5, 8, 13, 15, 16, 17, 20, 21, 22, 23, 25, 26, 31).

Calamagrostis blanda Beal, Grasses N. Am. 2:346. 1896; (2).

5. *Agrostis* L.

Palea evident, 2-nerved.
- Plants tufted. A dwarf alpine species. ---------- 1. *A. humilis.*
- Plants with rhizomes or stolons. A tall species of lower altitudes.--- 2. *A. palustris.*

Palea wanting, or a small nerveless scale.
- Panicle narrow, usually a part of the lower branches, spikelet-bearing from the base. ---------- 3. *A. exarata.*
- Panicle open, sometimes diffusely spreading, usually no short branches in the lower whorls of branches.
  - Panicle very diffuse, the branches capillary, spikelet-bearing toward the tips. ---------- 4. *A. hiemalis.*
  - Panicle open but not diffuse. ---------- 5. *A. idahoensis.*

1. *Agrostis humilis* Vasey, Bull. Torr. Club 10: 21. 1883; (1, 2, 5, 15, 16, 20, 23).

2. *Agrostis palustris* Huds., Fl. Angl. 27. 1762; (22, 23, 25, 26, 31).

3. *Agrostis exarata* Trin., Gram. Unifl. 207. 1824; (1, 5, 13, 15, 16, 17, 19, 22, 23, 24, 25, 26).

Agrostis asperifolia Trin., Mem. Acad. St. Petersb. VI. Sci. Nat. 4(1): 317. 1841; (20).

4. *Agrostis hiemalis* (Walt.) B.S.P., Prel. Cat. N. Y. 68. 1888; (2, 5, 8, 13, 16, 17, 20, 22, 23, 24, 25, 26, 31).

Agrostis scabra Willd., Sp. Pl. 1:370. 1797; (1).

5. *Agrostis idahoensis* Nash, Bull. Torr. Club 24: 42. 1897; (1, 5, 8, 13, 17, 20, 23, 24, 25, 26).

Agrostis tenuiculmis Nash, in Rydb., Mem. N. Y. Bot. Gard. 1:32. 1900; (1, 2).

6. *Muhlenbergia* Gmel.

1. *Muhlenbergia filiformis* (Thurb.) Rydb., Bull. Torr. Club 32: 600. 1905; (20, 21, 23, 24, 25, 26).

Sporobolus filiformis (Thurb.) Rydb., Contrib. U. S. Nat. Herb. 3:189. 1895; (1, 5).

7. *Trisetum* Pers.

1. *Trisetum spicatum* (L.) Richt., Pl. Eur. 1: 59. 1890; (5, 8, 12, 13, 15, 16, 17, 21, 22, 23, 24, 25, 26).

Trisetum subspicatum Beauv., Ess. Agrost. 88. 1812; (1, 2, 20).

8. *Aira* L.

- Blades firm, narrow, becoming folded or revolute, glumes about as long as or shorter than the upper floret. ---------- 1. *A. caespitosa.*
- Blades thin, flat. Glumes longer than the florets. ---------- 2. *A. atropurpurea.*

1. *Aira caespitosa* L., Sp. Pl. 64. 1753; (5, 13, 22, 23, 25, 26).

Deschampsia caespitosa Beauv., Ess. Agrost. 91, 160, pl. 18. f. 3. 1812; (1, 2, 8, 12, 15, 16, 17, 20, 21, 24, 31).

Deschampsia caespitosa Beauv. var. *confinis* Vasey in Beal, Grasses N. Am. 2:369. 1896; (20).

2. *Aira atropurpurea* Wahl., Fl. Lapp. 37. 1812; (22, 23).

Deschampsia atropurpurea (Wahl.) Scheele, Flora 27:56. 1844; (1, 5, 12, 15, 16, 20, 31).

9. *Pleuropogon* R. Br.

1. *Pleuropogon refractus* (Gray) Benth. in Vasey, Grasses of U. S. 40. 1883; (5, 15, 16, 23, 25).

10. *Dactylis* L.

1. *Dactylis glomerata* L., Sp. Pl. 71. 1753; (1, 2, 5, 8, 10, 12, 13, 15, 16, 17, 19, 20, 23, 24, 25, 26, 31).

11. *Bromus* L.

Spikelets strongly flattened, the lemmas distinctly compressed-keeled. Plants mostly perennial. ---------- 1. *B. marginatus.*

Spikelets not distinctly flattened or keeled.

Creeping rhizomes present. Lemmas glabrous, awnless or mucronate. Panicle somewhat open, the branches ascending. ---------- 2. *B. inermis.*

Creeping rhizomes absent. Panicle narrow, the branches erect. Lemmas appressed-pubescent on the margins and on the lower part.---- 3. *B. Suksdorfii.*

1. *Bromus marginatus* Nees in Steud., Syn. Pl. Glum. 1: 322. 1854; (1, 5, 8, 12, 13, 15, 16, 19, 22, 23, 24, 25, 26).

Bromus marginatus Nees var. *seminudus* Shear, U. S. Dept. Agr. Div. Agrost. Bull. 23:55. 1900; (17, 21, 23, 25).

2. *Bromus inermis* Leyss. Fl. Hal. 16. 1761; (1, 8, 12, 15, 20, 22, 23, 26, 27, 31).

3. *Bromus Suksdorfii* Vasey, Bot. Gaz. 10: 223. 1885; (1, 5, 21, 23, 25).

12. *Poa* L.

Creeping rhizomes present.

Lemmas without cobwebby hairs at base. ---------- 1. *P. nervosa.*

Lemmas with a tuft of cobwebby hairs at base. ---------- 2. *P. pratensis.*

Creeping rhizomes wanting.

Rachilla minutely scabrous. Lemma glabrous or minutely scabrous.--- 3. *P. ampla.*

Rachilla smooth. Lemmas short villous, especially near the base. Panicles longer than broad, nodding, the lower branches slender, ascending, drooping above. ---------- 4. *P. stenantha.*

1. *Poa nervosa* (Hook.) Vasey, U. S. Dept. Agr. Div. Agrost. Bull. 13: pl. 81. 1893; (1, 2, 5, 8, 15, 16, 20, 23, 25).

2. *Poa pratensis* L., Sp. Pl. 67. 1753; (1, 2, 5, 8, 10, 12, 13, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 31).

3. *Poa ampla* Merr., Rhodora 4: 145. 1902; (5, 13, 20, 23, 26).

4. *Poa stenantha* Trin., Mem. Acad. St. Petersb. VI. Math. Sci. Nat. 1: 376. 1831; (23).

13. *Melica* L.

1. *Melica aristata* Thurb. in Boland, Proc. Calif. Acad. 4: 103. 1870; (1, 5, 15, 23, 25).

14. *Glyceria* R. Br.

Lemmas with 7 prominent nerves. ----------1. *G. elata.*
Lemmas with 5 prominent nerves. ----------2. *G. erecta.*

1. *Glyceria elata* (Nash) Hitchc. in Jepson, Fl. Calif. 1: 162. 1912; (24, 25).

Panicularia elata Nash, in Rydb., Mem. N. Y. Bot. Gard. 1:54. 1900; (2, 20, 23, 26).

Panicularia nervata (Willd.) Kuntze var. *elata* (Nash) Piper, Contrib. U. S. Nat. Herb. 11:140. 1906; (5, 13, 16, 22).

2. *Glyceria erecta* Hitchc., in Jepson, Fl. Calif. 1: 161. 1912; (25).

15. *Lolium* L.

1. *Lolium perenne* L., Sp. Pl. 83. 1753; (1, 5, 8, 10, 12, 15, 16, 17, 19, 20, 23, 24, 25, 26, 31).

16. *Agropyron* Gaertn.

1. *Agropyron repens* (L.) Beauv., Ess. Agrost. 102, 146. 1812; (1, 5, 12, 13, 15, 16, 23, 25, 31).

17. *Hordeum* L.

1. *Hordeum nodosum* L. Sp. Pl. ed. 2. 1: 126. 1762; (1, 2, 5, 8, 10 ,12, 13, 15, 16, 17, 19, 20, 22, 23, 24, 25, 26, 31).

18. *Elymus* L.

Spike rather stout, about 8-10 mm. thick, if slender then not dense. Blades usually 5-10 mm. wide. Glumes broader than the following species, distinctly nerved. ----------1. *E. glaucus.*
Spike slender and dense, about 5 mm. thick. Blades narrow, mostly 2-4 mm. wide. Glumes narrow, faintly nerved. ----------2. *E. Macounii.*

1. *Elymus glaucus* Buckl., Proc. Acad. Phila. 1862: 99. 1863; (1, 2, 5, 8, 10, 13, 15, 16, 17, 19, 20, 22, 23, 24, 26, 31).

Elymus glaucus Buckl. var. *breviaristatus* Davy in Jepson, Fl. West. Mid. Calif. 79. 1901; (10).

Elymus glaucus Buckl. var. *maximus* Davy in Jepson, Fl. West. Mid. Calif. 79. 1901; (10).

Elymus angustifolius Davy in Jepson, Fl. West Mid. Calif. 80. 1901; (10).

Elymus angustifolius Davy var. *caespitosus* Davy in Jepson, Fl. West. Mid. Calif. 81. 1901; (10).

2. *Elymus Macounii* Vasey, Bull. Torr. Club 13: 119. 1886; (2, 8, 15, 17, 20, 23, 25, 26, 31).

19. *Sitanion* Raf.

1. *Sitanion hystrix* (Nutt.) J. G. Smith, U. S. Dept. Agri. Div. Agrost. Bull. 18. 15. pl. 2. 1899; (5, 8, 13, 20, 23, 25, 26, 31).

Sitanion elymoides Raf., Jour. Phys. 89:103. 1819; (1).

Sitanion rigidum J. G. Smith, U. S. Dept. Agri. Div. Agrost. Bull. 18:13. 1899; (16).

Sitanion californicum J. G. Smith, U. S. Dept. Agri. Div. Agrost. Bull. 18:13. 1899; (19).

Sitanion glabrum J. G. Smith, U. S. Dept. Agri. Div. Agrost. Bull. 18:14. 1899; (24).

CYPERACEAE. Sedge Family

Flowers unisexual, borne in the same or in separate spikelets. ----------1. *Carex.*

Flowers of the spikelets all perfect, rarely partly aborted. Spikelets all alike.

Style swollen at the base, persistent on the achene. ----------2. *Eleocharis.*

Style not swollen at the base, deciduous.

Bristles many, much elongated. ----------3. *Eriophorum.*

Bristles few, short. ----------4. *Scirpus.*

1. *Carex* L.*

Spike one. Perigynia strongly inflated. ----------Section I. *Inflatae.*

Spikes more than one. Perigynia not strongly inflated.

Stigmas 2. Achenes lenticular.

Lateral spikes sessile, short (rarely somewhat elongated) the terminal one androgynous or gynaecandrous.

Perigynia not white-punticulate.

Spikes androgynous. Perigynia with the body tapering into the beak. ----------Section II. *Stenorhynchae.*

Spikes gynaecandrous.

Perigynia at most thin edged.

Perigynia spreading or ascending at maturity. ---------- Section III. *Stellulatae.*

Perigynia appressed. ----------Section IV. *Deweyanae.*

Perigynia narrowly to broadly wing-margined.---------- Section V. *Stellulatae.*

Perigynia white-punticulate. ----------Section VI. *Canescentes.*

Lateral spikes elongated, peduncled or sessile. The terminal spike staminated, or if rarely gynaecandrous, the lateral spikes peduncled. Achenes not constricted in the middle. ---------- Section XII. *Acutae.*

Stigmas 3. Achenes triangular.

Perigynia pubescent.

Pistillate spikes with few to about 25 perigynia--Section VII. *Montanae.*

Pistillate spikes very many-flowered. ----------Section XIII. *Hirtae.*

Perigynia glabrous.

Lowest bract strongly sheathing.

Scales greenish or light reddish-brown tinged. Pistillate spikes slender on slender peduncles, the lower drooping. ---------- Section VIII. *Debiles.*

Scales dark reddish-brown to blackish tinged. -Section IX. *Frigidae.*

Lowest bract sheathless or very short sheathed.

Plants long-stoloniferous, not cespitose. ------Section X. *Limosae.*

Plants cespitose. ----------Section XI. *Atratae.*

Section I. *Inflatae*

Scales 3-nerved. Perigynia broadly ovoid, strongly inflated, very abruptly short-beaked. ----------1. *C. Breweri.*

* Based on the key of K. K. Mackenzie in Abrams, An Illustrated Flora of the Pacific States, and used by permission.

Section II. *Stenorhynchae*

Sheaths cross-rugulose ventrally, convex and prolonged at mouth. Perigynia very shallowly bidentate. ----------2. *C. neurophora.*

Section III. *Stellulatae*

Spikes in a small (6-10 mm. long) densely capitate brownish-black head.----------3. *C. illota.*

Spikes more or less widely separate, not brownish-black.

Beak of pergynium with few weak serrulations, the body broadest near the middle. ----------4. *C. laeviculmis.*

Beak of perigynium strongly serrulate, the body broadest near the base. ----------5. *C. angustior.*

Section IV. *Deweyanae*

Perigynia deeply bidentate, 4-4.5 mm. long, the beak about one-half the length of the body.----------6. *C. Bolanderi.*

Section V. *Ovales*

Lower bracts leaflet-like, much exceeding the head. ----------7. *C. athrostachya.*

Lower bracts not leaflet-like, from much shorter than to slightly exceeding the head.

Sheaths strongly prolonged upward at mouth opposite blade in a quickly ruptured, very membranaceous appendage. Perigynia and scales greenish.----------8. *C. fracta.*

Sheaths (upper ones at least) concave or truncate at mouth opposite blades, not quickly ruptured.

Beak of perigynium flat and serrulate to the often strongly bidentate tip.

Perigynia narrowly to broadly ovate, 3-4 mm. long, the beak subterete toward the tip. ----------9. *C. subfusca.*

Perigynia averaging 4-8.5 mm. long, membranaceous, flattened, concave-convex, with wide thin margins conspicuously crinkled dorsally. Scales with light slender mid-vein. ----------10. *C. straminiformis.*

Beak of perigynium terete towards apex, the upper 1-3 mm. smooth or nearly so (except *C. subfusca.*)

Perigynia appressed, nearly or entirely covered by scales, the beaks not conspicuous in the spikes and not hyaline at orifice. Spikes approximate. ----------11. *C. Tracyi.*

Perigynia conspicuous in the spikes, not covered by the scales.

Perigynia with thin submembranaceous walls, ovate, strongly margined, appressed. ----------12. *C. festivella.*

Perigynia with thick firm walls, plano-convex, nerveless or inconspicuously nerved on inner face, appressed. ----------9. *C. subfusca.*

Section VI. *Canescentes*

Spikes androgynous. Perigynia unequally bi-convex. ----------13. *C. disperma.*

Spikes gynaecandrous. Perigynia plano-convex, appressed-ascending, scarcely beaked, with emarginate or entire orifice. ----------14. *C. canescens.*

Section VII. *Montanae*

Basal spikes not developed. ----------15. *C. inops.*

Section VIII. *Debiles*

Perigynia ovoid-lanceolate, 4-5 mm. long, tapering into the beak, the sides strongly ribbed. ----------16. *C. Whitneyi.*

Section IX. *Frigidae*

Perigynia compressed-triangular. Uppermost pistillate spikes bunched, usually little exceeded by the staminate one. Scale dark-tinged. ----------17. *C. ablata.*

Section X. *Limosae*

A single species occurs on the Pacific Coast, which is----------18. *C. limosa.*

Section XI. *Atratae*

Culms few-leaved, purplish-tinged at base, the lower culm-leaves reduced. Pistillate scales with prominent excurrent midvein. Perigynia nerveless or nearly so on the inner face. ----------19. *C. spectabilis.*

Section XII. *Acutae*

Culms stoloniferous, arising one or few together, low. Lowest bract normally much shorter than the inflorescence. Scales with obsolete or slender midvein.

Dried first-year leaf-blades at base of fertile culm stiff, rigid, and conspicuous, concealing the culms. Fertile culm-leaves all blade-bearing, the lower sheaths not purplish or hispidulous dorsally. ----------20. *C. scopulorum.*

Dried first-year leaf-blades at base of fertile culms much desiccated, not stiff, rigid, nor conspicuous, and not concealing the culms. Lowest fertile culm-leaves (of season's growth) not blade-bearing, the lower sheaths purplish and more or less strongly hispidulose dorsally.

Perigynia plano-convex or slightly bi-convex, appressed ascending.----------21. *C. gymnoclada.*

Perigynia mostly deeply concave ventrally, convex dorsally, curved outward and spreading. ----------22. *C. campylocarpa.*

Culms taller, less stiff, in larger clumps. Lowest bract usually equalling or exceeding the inflorescence. Scales with slender midvein or broader light-colored center.

Perigynia strongly nerved ventrally, the nerves raised.

Perigynia coriaceous, sessile or nearly so, the beak bidentate. Plants strongly stoloniferous. ----------23. *C. nebraskensis.*

Perigynia membranaceous, more or less slenderly stipitate, the beak entire. Plants cespitose. Scales long persistent. ----------24. *C. Kelloggii.*

Perigynia nerveless ventrally or with obscure impressed nerves.

Perigynia turgid. The scales divaricate at maturity. ----------25. *C. aperta.*

Perigynia not turgid. Scales appressed. Sheaths colored ventrally at mouth. Lower pistillate spikes subcernuous in long peduncles.----------26. *C. sitchensis.*

Section XIII. *Hirtae*

Perigynia hairy. The beak deeply bidentate. Lowest bract strongly sheathing. The fertile culms phylopodic with many leaves, the sheaths not breaking and becoming filamentose. ----------27. *C. oregonensis.*

1. *Carex Breweri* Boott, Ill. Carex 4: 142. pl. 455. 1867; (1, 16, 21, 23, 25).

2. *Carex neurophora* Mackenzie, in Abrams, Ill. Fl. Pac. States 1: 298. 1923; (23).

The specimens collected at Crater Lake were not sufficiently mature to permit positive determination. These specimens differ from the type material in being roughened above, and the scales being more than half as long as the perigynia.

3. *Carex illota* Bailey, Mem. Torrey Club 1: 15. 1889; (5, 8, 15, 16, 20, 21, 23, 25).

4. *Carex laeviculmis* Meinsh., Bot. Centralbl. 55: 195. 1893; (5, 13, 15, 16, 20, 22, 23, 25).

5. *Carex angustior* Mackenzie, in Rydb., Fl. Rocky Mts. 124. 1917; (20, 23, 25, 26, 31).

6. *Carex Bolanderi* Olney, Proc. Am. Acad. 7: 393. 1868; (5, 13, 16, 20, 23, 24, 25, 26).

Carex Deweyana Boott var. *Bolanderi* Boott, in Wats., Bot. Calif. 2: 236. 1880; (10).

7. *Carex athrostachya* Olney, Proc. Am. Acad. 7: 393. 1868; (1, 2, 5, 8, 13, 15, 16, 20, 21, 22, 23, 24, 25, 26).

8. *Carex fracta* Mackenzie, Erythea 8: 38. 1922; (23, 24, 25).

The specimens from Crater Lake were too immature for positive determination.

9. *Carex subfusca* Boott, in Wats., Bot. Calif. 2: 234. 1880; (17, 23, 25, 26).

10. *Carex straminiformis* Bailey, Mem. Torr. Club 1: 24. 1889; (1, 5, 21, 23, 25, 26).

11. *Carex Tracyi* Mackenzie, Erythea 8: 41. 1922; (23, 25).

12. *Carex festivella* Mackenzie, Bull. Torrey Club 42: 609. 1915; (20, 22, 23, 25, 26, 31).

13. *Carex disperma* Dewey, Am. Jour. Sci. 8: 266. 1824; (1, 5, 17, 20, 22, 23, 25, 26).

14. *Carex canescens* L., Sp. Pl. 974. 1753; (1, 2, 8, 12, 15, 16, 20, 21, 22, 23, 25, 26, 31).

15. *Carex inops* Bailey, Proc. Am. Acad. 22: 126. 1886; (1, 23, 25).

Carex vespertina Howell, Fl. N. W. Am. 705. 1903; (1, 5, 17).

16. *Carex Whitneyi* Olney, Proc. Am. Acad. 7: 394. 1868; (21, 23, 25).

17. *Carex ablata* Bailey, Bot. Gaz. 13: 82. 1888; (2, 5, 8, 15, 16, 23, 25).

18. *Carex limosa* L., Sp. Pl. 944. 1753; (1, 5, 15, 20, 21, 23, 31).

19. *Carex spectabilis* Dewey, Am. Jour. Sci. 29: 248. pl. 10. 8. 76. 1836; (5, 16, 20, 23, 25).

Carex invisa Bailey, Prox. Am. Acad. 22: 82. 1886; (1, 15).

20. *Carex scopulorum* Holm, Am. Jour. Sci. IV. 14: 421. t. 1-6. 1902; (5, 8, 16, 17, 20, 23, 25).

21. *Carex gymnoclada* Holm, Am. Jour. Sci. IV. 14: 424. t. 12-14. 1902; (5, 16, 23, 25).

22. *Carex campylocarpa* Holm, Am. Jour. Sci. IV. 20: 304. t. 13-15. 1905; (23).

23. *Carex nebraskensis* Dewey, Am. Jour. Sci. II. 18: 102. 1854; (1, 2, 5, 8, 13, 15, 17, 20, 22, 23, 24, 25, 26, 31).

The Crater Lake specimens resemble *C. Kelloggii*, but material collected at Pole Bridge Creek seems nearer *C. nebraskensis*, although the rootstocks are but slightly developed.

24. *Carex Kelloggii* Boott, in Wats., Bot. Calif. 2: 240. 1880; (1, 5, 13, 16, 17, 20, 21, 23, 25, 26).

The Crater Lake specimens have achenes but little stipitate, and the perigynia abruptly beaked.

25. *Carex aperta* Boott, in Hook., Fl. Bor. Am. 2: 218. pl. 219. 1840; (5, 15, 16, 20, 23, 26).

Carex bovina Howell, Fl. N. W. Am. 1: 702. 1903; (1).

26. *Carex sitchensis* Prescott, Mem. Acad. St. Peterbs. II. 6: 169. 1832; (1, 5, 10, 15, 16, 23, 25).

Carex Howellii Bailey, Mem. Torrey Bot. Club 1: 45. 1889; (1, 15).

27. *Carex oregonensis* Olney, Proc. Am. Acad. 8: 407. 1872; (1, 5, 16, 23, 25).

2. *Eleocharis* R. Br.

1. *Eleocharis rostellata* Torr., Fl. N. Y. 2: 347. 1843; (1, 2, 5, 8, 15, 16, 17, 19, 20, 23, 24, 25, 26, 31).

Eleocharis rostellata Torr. var. *Congdoni* Jepson, Fl. Cal. 196. 1922.

3. *Eriophorum* L.

1. *Eriophorum gracile* Koch in Roth, Catal. Bot. 2: 259. 1800; (2, 5, 8, 10, 15, 16, 20, 23, 25, 26, 31).

4. *Scirpus* L.

Style-branches 2. Achene plano-convex. ---------- 1. *S. microcarpus.*
Style-branches 3. Achene trigonous. ---------- 2. *S. Congdoni* var.

1. *Scirpus microcarpus* Presl, Rel. Haenk. I: 195. 1828; (1, 2, 5, 8, 10, 13, 15, 16, 17, 19, 20, 21, 23, 24, 25, 26, 31).

2. *Scirpus Congdoni* Britton var. *minor* Henderson, Rhodora 32: 21. 1930.

JUNCACEAE. Rush Family

Leaf-sheaths open. Capsule 1-celled or 3-celled. ---------- 1. *Juncus.*
Leaf-sheaths closed. Capsule 1-celled, 3-seeded. ---------- 2. *Luzula.*

1. *Juncus* L.

Lowest leaf of the inflorescence terete, not conspicuously channelled, erect, exactly simulating a continuation of the stem, the inflorescence therefore appearing lateral.
  Inflorescence usually 1-3 flowered, rarely 4-5 flowered. Seeds with conspicuous white tails at either end.
    Blade of the uppermost basal leaf-sheath well developed. Capsule acute. ---------- 1. *J. Parryi.*
    Blade of the uppermost basal leaf-sheath reduced to a mere rudiment. Capsule retuse. ---------- 2. *J. Drummondii.*
  Inflorescence of many flowers, rarely reduced to 3-5 flowers in depauperate plants. Seeds not tailed.
    Stamens 3, opposite the outer perianth-segments. ---------- 3. *J. effusus.*
    Stamens 6, opposite the inner and outer perianth-segments. ---------- 4. *J. balticus.*
Lowest leaf of the inflorescence not exactly simulating a continuation of the stem, or if so, conspicuously channelled along the inner side. Inflorescence usually appearing terminal.

Leaf-blades transversely flattened (inserted with the flat surface facing the stems) not provided with septae. ----------5. *J. Regelii.*

Leaf-blades terete or gladiate, never transversely flattened, the septae usually conspicuous and complete except in the species with gladiate leaves.

Blades terete or somewhat compressed but not gladiate, the septae incomplete. ----------6. *J. Mertensianus.*

Blades gladiate, the septae incomplete. ----------7. *J. ensifolius.*

1. *Juncus Parryi* Engelm., Trans. St. Louis Acad. 2: 446. 1866; (1, 2, 5, 8, 13, 15, 16, 20, 21, 22, 23, 24, 25, 26).

2. *Juncus Drummondii* Meyer in Ledeb., Fl. Ross. 4: 235. 1853; (1, 17, 20, 21, 22, 23, 25, 26).

Juncus subtriflorus Coville, Contr. U. S. Nat. Herb. 4: 208. 1893; (8, 16).

3. *Juncus effusus* L., Sp. Pl. 326. 1753; (1, 5, 10, 15, 16, 19, 23, 24, 25, 26, 31).

4. *Juncus balticus* Willd., Berlin Mag. 3: 298. 1809; (1, 2, 5, 8, 15, 16, 17, 19, 22, 23, 24, 25, 26).

5. *Juncus Regelii* Buch., Engler Bot. Jahrb. 12: 414. 1890; (13, 16, 20, 22, 23, 26).

6. *Juncus Mertensianus* Bong., Mem. Acad. St. Petersb. VI. 2: 167. 1832; (1, 2, 5, 8, 13, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26).

7. *Juncus ensifolius* Wiks., Kongl. Vet. Akad. Handl. 2: 274. 1823; (1, 2, 5, 8, 13, 15, 16, 20, 21, 22, 23, 25).

2. *Luzula* DC.

Flowers congested into 1 to several spike-like or head-like clusters.--- 1. *L. campestris.*

Flowers in clusters of 2 or 3 solitary in an open panicle.

Seeds brown.

Inflorescence spreading, not nodding. Capsule 2.5-3.5 mm. long.--------
----------2. *L. glabrata.*

Inflorescence ultimately nodding. Capsules 1.5-2.5 mm. long. 3. *L. parviflora.*

Seeds yellow, constricted at each end. ----------4. *L. divaricata.*

1. *Luzula campestris* (L.) DC., Fl. Fr. 3: 161. 1805; (15, 25).

Juncoides campestre (L.) Kuntze, Rev. Gen. Pl. 722. 1891; (1, 2, 5, 13, 16, 22, 23, 26).

2. *Luzula glabrata* (Hoppe) Desv., Jour. de Bot. 1: 45. 1808.

Juncoides glabratum (Hoppe) Sheldon, Minn. Bot. Stud. Bull. 9: 63. 1894; (2, 5, 13, 16, 20, 22, 23, 26).

3. *Luzula parviflora* (Ehrh.) Desv., Jour. Bot. 1: 144. 1808; (8, 15, 25, 31).

Juncoides parviflorum (Ehrh.) Coville, Contr. U. S. Nat. Herb. 4: 209. 1893; (1, 2, 5, 13, 16, 17, 20, 22, 23, 26).

The perianth varies from light green to almost black. The capsule grades gradually from the typical obtuse form to quite acute. There is also a wide variation in the color of the capsule.

4. *Luzula divaricata* Wats., Proc. Am. Acad. 14: 302. 1879; (15, 21, 25).

Juncoides divaricatum (Wats.) Coville, Contr. U. S. Nat. Herb. 4: 209. 1893; (5, 16, 23, 26).

LILIACEAE. Lily Family

Fruit a berry.
Leaves basal. Flowers solitary or umbellate. ---------- 1. *Clintonia.*
Leaves alternate.
Flowers in terminal racemes or panicles. ---------- 2. *Smilacina*
Flowers axillary, usually solitary. ---------- 3. *Streptopus.*
Fruit a capsule.
Capsules septicidal. Plants usually from rootstocks.
Leaves narrow, grass-like. ---------- 4. *Tofieldia.*
Leaves broad, not grass-like. ---------- 5. *Veratrum.*
Capsules loculicidal (except Calochortus). Plants from bulbs or corms.
Perianth segments unlike, the inner petaloid, the outer smaller and often sepal-like. ---------- 6. *Calochortus.*
Perianth segments all alike, petaloid.
Flowers in umbels terminating a scape. ---------- 7. *Allium.*
Flowers not in umbels, or if so, not terminating an evident scape.
Bracts scarious. Perianth present. Flowers in a raceme terminating a scape. Plants of marshy habitat. ---------- 8. *Camassia.*
Bracts, if any, foliaceous. Perianth deciduous.
Plants from scaly bulbs.
Anthers versatile. ---------- 9. *Lilium.*
Anthers fixed near the base. ---------- 10. *Fritillaria.*
Plants from truncated bulbs. Anthers strictly basifixed. ---------- 11. *Erythronium.*

1. *Clintonia* Raf.

1. *Clintonia uniflora* (Schult.) Kunth., Enum. 5: 159. 1850; (1, 2, 4, 5, 6, 7, 11, 12, 13, 14, 15, 16, 20, 22, 23, 25, 29).

2. *Smilacina* Desf.

Flowers paniculate, subsessile at least not with pedicels as long as the following, numerous. ---------- 1. *S. amplexicaulis* var.
Flowers racemose, few. Pedicels equalling or longer than the flowers.
Leaves flat and spreading. Raceme zigzag. Pedicels widely spreading. ---------- 2. *S. sessilifolia.*
Leaves folded, ascending. Raceme seldom zigzag. Pedicels ascending. 3. *S. liliacea.*

1. *Smilacina amplexicaulis* Nutt. var. *glabra* Macbr., Contrib. Gray Herb. n. ser. 56: 18. 1918; (21, 25, 27).

Vagnera amplexicaulis (Nutt.) Greene, var. *glabra* (Macbr.) Abrams, Ill. Fl. Pac. States 1: 453. 1923; (23).

2. *Smilacina sessilifolia* Nutt. in Wats., Proc. Am. Acad. 14: 245. 1879; (1, 8, 10, 15, 18, 21, 24, 25, 29).

Vagnera sessilifolia (Nutt.) Greene, Bot. Bay Region 316. 1894; (5, 7, 11, 12, 13, 14, 16, 20, 22, 23, 24).

The separation of this species from the following is often difficult. A single specimen, without fruit, from Crater Lake agrees with the figure given by Abrams (Ill. Fl. Pac. States 1: 454. f. 1114. 1923).

3. **Smilacina liliacea** (Greene) Wynd, comb. nov.

Unifolium liliaceum Greene, Pittonia 1: 280. 1889.

Vagnera liliacea (Greene) Rydb., Mem. N. Y. Bot. Gard. 1: 101. 1900; (2, 20, 23, 26).

The specimens from Crater Lake agree with the figure given by Abrams (Ill. Fl. Pac. States 1: 454. f. 1115. 1934.) While we have not studied the mature fruit from the Crater Lake plants, the specimens agree in stem and leaves with those from the vicinity of Eugene, Lane County, Oregon. The Eugene specimens have red berries. There is still considerable confusion regarding this and the preceding species. Jepson (Man. Fl. Pl. Calif. 249. 1923) states that *S. sessilifolia* has the red berries while *S. stellata* has black fruit.

3. *Streptopus* Michx.

Leaves glaucous beneath, strongly clasping at the base. Flowers greenish-white. Stigma entire. ----------1. *S. amplexifolius.*

Leaves green on both sides, slightly clasping. Flowers rose-purple. Stigma 3-cleft. ----------2. *S. curvipes.*

1. *Streptopus amplexifolius* (L.) DC., Fl. France 3: 174. 1805; (1, 2, 4, 5, 6, 7, 8, 12, 13, 14, 16, 17, 20, 22, 23, 25, 26, 29).

2. *Streptopus curvipes* Vail., Bull. Torr. Club 28: 267. 1902; (4, 6, 16, 20, 23).

Streptopus roseus Michx., Fl. Bor. Am. 1: 201. t. 18. 1803. (Of western authors); (1, 5, 7, 12).

This species has commonly been taken for *S. roseus* Michx. of the eastern states, but it may be distinguished from that species by its simple stem. Any separation of these species on the length of the peduncles or root-stocks is unreliable, as forms from the eastern states have been found with peduncles and root-stocks very similar to the western species.

4. *Tofieldia* Huds.

1. *Tofieldia occidentalis* Wats., Proc. Am. Acad. 14: 283. 1879; (1, 6, 12, 15, 21, 23, 25).

5. *Veratrum* L.

1. *Veratrum viride* Ait., Hort. Kew. 3: 422. 1789; (1, 4, 5, 6, 12, 13, 15, 16, 22, 23, 25, 29).

6. *Calochortus* Pursh

1. *Calochortus elegans* Pursh, Fl. Am. Sept. 1: 240. 1814; (1, 5, 12, 13, 15, 20, 22, 23, 26).

7. *Allium* L.

1. *Allium validum* Wats., Bot. King Exp. 350. 1871; (1, 5, 11, 12, 16, 20, 21, 23, 25, 26, 28).

8. *Camassia* Raf.

1. *Camassia esulenta* Lindl., Bot. Reg. 18: pl. 1486. 1832; (1, 7, 8, 10, 31).

Camassia quamash (Pursh) Greene, Man. Bay Region 313. 1894; (11, 12, 14, 18, 19, 21, 25, 27, 29).

Quamasia quamash (Pursh) Coville, Proc. Biol. Soc. Wash. 11: 64. 1897; (2, 5, 13, 16, 20, 22, 23, 26).

9. *Lilium* L.

1. *Lilium washingtonianum* Kell., Proc. Calif. Acad. 2: 13. 1863; (1, 7, 9, 10, 11, 12, 14, 16, 23, 24, 25, 28, 29).

10. *Fritillaria* (Tourn.) L.

1. *Fritillaria atropurpurea* Nutt., Jour. Acad. Phila. 7: 54. 1834; (1, 2, 7, 8, 11, 12, 14, 17, 20, 23, 24, 25, 26, 27, 31).

11. *Erythronium* L.

1. *Erythronium parviflorum* (Wats.) Goodding, Bot. Gaz. 33: 67. 1902; (5, 8, 12, 13, 14, 16, 20, 23, 26, 28, 29).

Erythronium grandiflorum Pursh var. *parviflorum* Wats., Proc. Am. Acad. 26: 129. 1891; (1, 15, 25, 27).

IRIDACEAE. Iris Family

Styles petal-like. Flowers large, perianth-segments in 2 unlike series. ——— 1. *Iris.*
Styles filiform. Flowers less than 1 inch across, perianth-segments all alike. ——— 2. *Sisyrinchium.*

1. *Iris* (Tourn.) L.

1. *Iris californica* Leicht., Garden 52: 126. 1897; (23).

The specimens from Crater Lake are not typical, but their differences do not seem worthy of specific or varietal characters.

2. *Sisyrinchium* L.

1. *Sisyrinchium idahoense* Bick., Bull. Torrey Club 26: 445. 1899; (1, 5, 13, 15, 16, 20, 23, 29).

Sisyrinchium segetum Bick., Bull. Torrey Club 26: 449. 1899: (1).

Our plant agrees with the description given by Abrams (Ill. Fl. Pac. States). Bicknell describes a flower, larger than any we have ever seen. Little diagnostic importance can be placed on the length of the floral bracts.

ORCHIDACEAE. Orchid Family

Plants saprophytic, without green herbage. ——— 1. *Corallorrhiza.*
Plants with ordinary green herbage.
  Leaves only 2. ——— 2. *Listera.*
  Leaves more than 2.
    Flowers each with a distinct spur. ——— 3. *Habenaria.*
    Flowers spurless, the lip at most saccate. ——— 4. *Spiranthes.*

1. *Corallorrhiza* (Haller) Chatelain

Spur free for its apical half. Lip entire, not spotted. ——— 1. *C. Mertensiana.*
Spur wholly adnate to the ovary. Lip 3-lobed, spotted. ——— 2. *C. maculata.*

1. *Corallorrhiza Mertensiana* Bong., Mem. Acad. St. Petersb. VI. 2: 165. 1832; (1, 2, 5, 12, 15, 16, 20, 22, 23, 25, 29).

2. *Corallorrhiza maculata* Raf., Am. Month. Mag. 2: 119. 1817; (2, 13. 16, 23, 24, 25, 27, 29, 31).

Corallorrhiza multiflora Nutt., Jour. Acad. Phila. 3: 138. pl. 7. 1823; (1, 6, 7, 8, 10, 11, 12, 14, 17, 18, 20, 22).

Corallorrhiza multiflora Nutt. var. *occidentalis* Lindl., Gen. & Sp. Orchid. 534. 1840; (5, 15).

2. *Listera* R. Br.

1. *Listera caurina* Piper, Erythea 6: 32. 1898; (1, 12, 15, 25).

Listera convallarioides Torr., Comp. 320. 1826.

Ophrys caurina (Piper) Rydb., Bull. Torr. Club 32: 610. 1905; (5, 13, 16, 20, 22, 23).

3. *Habenaria* Willd.

Cauline leaves gradually reduced upwards.
- Flowers green or sometimes purple-tinged. ----------1. *H. saccata.*
- Flowers white.
  - Spur usually shorter than or about equalling the lip. ---------2. *H. dilatata.*
  - Spur slender, 1/3 - 2/3 longer than the lip.----------3. *leucostachys.*

Cauline leaves reduced to bracts. ----------4. *H. unalaschensis.*

1. *Habenaria saccata* Greene, Erythea 3: 49. 1895; (25).

Habenaria gracilis (Lindl.) Wats., Proc. Am. Acad. 12: 277. 1877; (1).
Habenaria stricta (Lindl.) Rydb., Bull. Torr. Bot. Club 24: 189. 1897; (15).
Limnorchis stricta (Lindl.) Rydb., Mem. N. Y. Bot. Gard. 1: 105. 1900; (2, 5, 8, 12, 13, 16, 20, 23).

2. *Habenaria dilatata* (Pursh) Hook., Exot. Fl. pl. 95. 1825; (1, 4, 22, 26).

Habenaria borealis (Reichb.) Cham., Linnaea 3: 28. 1828; (15, 27).
Limnorchis dilatatiformis Rydb., Mem. N. Y. Bot. Gard. 1: 105. 1900; (2, 6).
Limnorchis borealis (Reichb.) Rydb., Bull. Torr. Club 28: 621. 1901; (6, 8, 17).
Limnorchis dilatata (Pursh) Rydb., Bull. Torr. Club 28: 622. 1901; (5, 12, 16, 20, 23, 31).

3. *Habenaria leucostachys* (Lindl.) Wats., Bot. Calif. 2: 134. 1880; (1, 4, 10, 11, 15, 18, 25).

Limnorchis leucostachys (Lindl.) Rydb., Mem. N. Y. Bot. Gard. 1: 106. 1900; (2, 5, 12, 14, 16, 19, 20, 23, 24).

Limnorchis leucostachys (Lindl.) Rydb. var. *robusta* Rydb., Bull. Torr. Club 28: 626. 1901; (5).

Habenaria dilatata (Pursh) Hook. var. *leucostachys* (Lindl.) Ames, Orchid. Fascicle 4: 71. 1910; (21, 26).

The variation in these orchids is so extensive, that Oakes Ames gave *H. leucostachys* only varietal rank. He even doubts its validity as a variety and suggests that it should probably be included in the synonymy of *H. dilatata.*

4. *Habenaria unalaschensis* (Spreng.) Wats., Proc. Am. Acad. 12: 277. 1877; (1, 11, 15, 21, 22, 25, 26).

Piperia unalaschensis (Spreng.) Rydb., Bull. Torr. Club 28: 270. 1901; (5, 8, 12, 13, 16, 20, 23, 31).

4. *Spiranthes* Rich.

1. *Spiranthes Romanzoffianum* Cham. & Schl., Linnaea 3: 32. 1828; (4, 7, 10, 11, 12, 15, 18, 21, 25).

Gyrostachys Romanzoffianum (Cham. and Schl.) McM., Met. Minn. 171. 1892; (1, 19).

Ibidium strictum (Rydb.) House, Bull. Torr. Club 32: 381. 1905; (20).

Ibidium Romanzoffianum (Cham. & Schl.) House, Muhlenbergia 1: 129. 1906; (5, 6, 13, 16, 21, 22, 23, 26).

Spiranthes stricta (Rydb.) A. Nels., in Coulter & Nels., Man. Bot. Rocky Mts. 125. 1909; (8).

SALICACEAE. Willow Family

Buds with several imbricated scales. Stamens numerous. ——1. *Populus.*
Buds with a single scale. Stamens 1-5. ——2. *Salix.*

1. *Populus* L.

Petiole strongly flattened laterally. ——1. *P. tremuloides.*
Petiole not strongly flattened latterally. ——2. *P. trichocarpa.*

1. *Populus tremuloides* Michx., Fl. Bor. Am. 2: 243. 1803; (1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 15, 20, 21, 22, 23, 24, 25, 27, 30, 31).

2. *Populus trichocarpa* Torr. & Gray in Hook., Icon. Pl. 9: pl. 878. 1852; (1, 3, 5, 7, 9, 10, 11, 12, 13, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 30).

2. *Salix* L.

Key based on the leaves:

Leaves distinctly oblanceolate, or obovate.
  Leaves covered beneath with a short appressed satiny pubescence.— 1. *S. sitchensis.*
  Leaves silvery (in age) to rusty-pubescent to glabrous and glaucous beneath. ——2. *S. Scouleriana.*
Leaves lanceolate.
  Leaves densely to sparsely silky-villous on both sides, paler to glaucescent and glabrescent beneath. ——3. *S. orestera.*
  Leaves more or less silky when young, becoming glabrous, deep green and shining above, and glabrescent and glaucescent beneath at maturity.—— ——4. *S. Lemmoni.*

Key based on the pistillate catkins:

Capsules subsessile. ——1. *S. sitchensis.*
Capsules borne on pedicels 1-1.5 mm. long.
  Stigmas long, sessile. ——2. *S. Scouleriana.*
  Stigmas shorter, borne on a style.
    Style 1 mm. long. ——3. *S. orestera.*
    Style .5 - .8 mm. long. ——4. *S. Lemmoni.*

Key based on the staminate catkins:

Staminate aments appearing before the leaves. ——2. *S. Scouleriana.*
Staminate aments appearing with the leaves.
  Stamens 1 to each scale of the ament. ——1. *S. sitchensis.*
  Stamens 2 to each scale of the ament.
    Leaves densely to thinly silky-villous on both sides. ——3. *S. orestera.*
    Leaves more or less silky-villous when young but becoming glabrous. ——4. *S. Lemmoni.*

Key based on general characters:

Styles distinct, .5-1 or 1.5 mm. long.
  Leaves more or less glabrate at maturity. ——4. *S. Lemmoni.*
  Leaves densely hairy, at least beneath, at maturity.
    Styles .7-1.5 mm. long. Stamens 2. ——3. *S. orestera.*
    Styles .5-.7 mm. long. Stamen 1. ——1. *S. sitchensis.*
Styles obsolete or very short, 0-.3 mm. long. ——2. *S. Scouleriana.*

1. *Salix sitchensis* Sanson in Bong., Mem. Acad. Imp. Sci. St. Petersb. VI. 2: 162. 1833; (1, 2, 3, 5, 7, 9, 10, 11, 12, 13, 15, 16, 20, 23, 30).

2. *Salix Scouleriana* Barratt in Hook., Fl. Bor. Am. 2: 145. 1839; (1, 5, 7, 11, 12, 13, 15, 16, 17, 19, 20, 22, 23, 25, 26, 30, 31).

Salix Nuttallii Sarg., Gard. & For. 8: 463. 1895; (3).

3. *Salix orestera* Schneider, Jour. Arn. Arb. 1: 164. 1920; (23, 25, 26).

Salix glauca L. var. *villosa* Anderss., Öfversight. Akad. Stockholm 127. 1858, of western authors.

S. orestera Schn. is intermediate between *S. commutata* and *S. Eastwoodiae*. Some specimens from Crater Lake are very difficult to place, but following C. R. Ball, only *S. orestera* is recognized. Benson (30) includes the Crater Lake specimens with *S. commutata* and its varieties.

4. *Salix Lemmoni* Bebb., Willows Calif. (repr. in Wats. Bot. Calif. 2: 88) 1897; (1, 12, 20, 21, 23, 25, 26).

Betulaceae. Birch Family

Fruit enclosed in a leafy involucre. ---------- 1. *Corylus*.
Fruit cone-like, without an involucre. ---------- 2. *Alnus*.

1. *Corylus* (Tourn.) L.

1. *Corylus californica* (A.DC.) Rose, Gard. & For. 8: 263. 1895; (1, 5, 12, 15, 16, 20, 21, 23).

Corylus rostrata Ait. var. *californica* A.DC. Prod. 16: 133. 1864. (10, 11, 25, 29).

2. *Alnus* (Tourn.) Hill

Leaves dull. Flowers opening before the leaves in early spring or winter. ---------- 1. *A. tenuifolia*.
Leaves shining. Flowers developing with the leaves. ---------- 2. *A. sinuata*.

1. *Alnus tenuifolia* Nutt., Sylva 1: 32. 1842; (1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 17, 20, 21, 22, 23, 25, 26, 27, 30).

2. *Alnus sinuata* (Regel) Rydb., Bull. Torr. Club 24: 190. 1897; (2, 5, 12, 13, 16, 20, 22, 23, 30, 31).

Alnus viridis DC. var. *sinuata* Regel in DC., Prod. 26: 183. 1868; (9, 25).

Alnus sitchensis Sarg., Silva N. Am. 14: 61. 1902; (15).

Fagaceae. Beech Family

1. *Castanopsis* Spach.

1. *Castanopsis chrysophylla* (Dougl.) A. DC., Seem. Jour. Bot. 1: 182. 1863; (1, 3, 5, 7, 9, 10, 12, 16, 23, 25, 29, 30).

Loranthaceae. Mistletoe Family

1. *Arceuthobium* Marsch.-Bieb.

1. *Arceuthobium americanum* Nutt. in Engelm. Bost. Jour. Nat. Hist. 6: 214.1850; (11, 15, 21, 25, 31).

Razoumofskaya americana Coville, Contri. U. S. Nat. Herb. 4: 192. 1893; (1, 2, 5, 6, 12, 13, 16, 20, 22, 23, 26).

POLYGONACEAE. Buckwheat Family

Flowers involucrate. Stipules wanting. ----------1. *Eriogonum.*
Flowers not involucrate. Stipules sheath-like.
  Leaves reniform. Sepals 4. ----------2. *Oxyria.*
  Leaves not reniform. Sepals 5 or 6.
    Sepals unequal, the inner becoming larger. Stigmas tufted. ----------3. *Rumex.*
    Sepals equal. Stigmas capitate. ----------4. *Polygonum.*

1. *Eriogonum* Michx.

Leaves narrowly linear, scarcely ½ inch long. Flowers small, scarcely 3 mm. across. ----------1. *E. spergulinum.*
Leaves not linear. Flowers larger.
  Flowers not stipe-like at base.
    Outer perianth segments much broader than the inner. Plants densely cespitose. ----------2. *E. ovalifolium.*
    Outer perianth segments like the inner. Plants not densely cespitose. ----------3. *E. nudum* var.
  Flowers narrow and stipe-like at base.
    Perianth pubescent. ----------4. *E. pyrolaefolium* var.
    Perianth glabrous.
      Umbel of 3-10 rays, each of which terminates in a capitate cluster of flowers. ----------5. *E. umbellatum.*
      Umbel of 2-4 rays, each of which is often repeatedly cymosely branched. ----------6. *E. stellatum.*

1. *Eriogonum spergulinum* Gray, Proc. Am. Acad. 7: 389. 1868; (20, 21, 25, 26).

2. *Eriogonum ovalifolium* Nutt., Jour. Acad. Phila. 7: 50. t. 8. f. 1, 1834; (1, 2, 5, 8, 15, 16, 17, 20, 21, 25, 26, 27).

3. *Eriogonum nudum* Dougl. var. *deductum* Jepson, Man. Fl. Pl. Calif. 314. 1925; (21).

4. *Eriogonum pyrolaefolium* Hook. var. *coryphaeum* Torr. & Gray, Proc. Am. Acad. 8: 162. 1870; (1, 5, 16).

The variety differs from the species in its narrow leaves, which are densely tomentose beneath, and in its smaller flowers.

5. *Eriogonum umbellatum* Torr., Ann. Lyc. N. Y. 2: 241. 1828; (1, 2, 4, 5, 8, 11, 15, 16, 18, 20, 21, 24, 25, 26, 27).

6. *Eriogonum stellatum* Benth., Trans. Linn. Soc. 17: 409. 1837; (1, 5, 10, 11, 13, 19, 20, 21, 26).

Eriogonum croceum Small, Bull. Torr. Club 26: 42. 1898; (1).

The primary umbel may be successfully trichotomously or dichotomously branched causing the inflorescence frequently to take the form of a loose cyme.

2. *Oxyria* Hill.

1. *Oxyria digyna* (L.) Campt., Monog. Rumex 155. pl. 3, fig. 3. 1819; (1, 2, 5, 6, 8, 10, 11, 12, 15, 16, 17, 20, 21, 22, 24, 25, 26).

3. *Rumex* L.

Flowers diocious. Leaves hastate. Plant small. ----------1. *R. Acetosella.*
Flowers not dioecious. Leaves not hastate. Plants coarse ----------2. *R. crispus.*

1. *Rumex Acetosella* L. Sp. Pl. 338. 1753; (1, 2, 4, 5, 8, 10, 11, 12, 13, 15, 16, 17, 19, 20, 22, 24, 25, 26, 27, 29, 31).

2. *Rumex crispus* L. Sp. Pl. 335. 1753; (5, 8, 10, 11, 12, 13, 15, 16, 17, 19, 20, 22, 24, 26, 27, 29, 31).

4. *Polygonum* L.

Leaves rather small. Stems wiry.
  Leaves rather broad, scarcely reduced upwards. ---- 1. *P. minimum.*
  Leaves narrow, decidedly reduced upwards.
    Fruiting pedicels erect. ---- 2. *P. sawatchense.*
    Fruiting pedicels reflexed. ---- 3. *P. Douglasii.*
Leaves larger. Stems not wiry.
  Flowers in a single dense, spike-like raceme. ---- 4. *P. bistortoides.*
  Flowers not in a single dense, spike-like raceme.
    Plants succulent. Leaves more than 1 cm. wide.---- 5. *P. Newberryi.*
    Plants low, woody shrubs. Leaves lanceolate, less 1 cm. wide.
    ---- 6. *P. shastense.*

1. *Polygonum minimum* Wats., Bot. King Explor. Exped. 315. 1871; (1, 2, 5, 11, 13, 15, 16, 20, 21, 25, 26).

2. *Polygonum sawatchense* Small, Bull. Torr. Club 20: 213. 1893; (1, 5, 8, 17, 20, 25, 26).

3. *Polygonum Douglasii* Greene, Bull. Calif. Acad. 1: 125. 1885; (1, 2, 5, 11, 13, 16, 20, 21, 25, 26, 31).

4. *Polygonum bistortoides* Pursh, Fl. Am. Sept. 271. 1814; (1, 2, 5, 8, 11, 12, 13, 14, 15, 16, 21, 25, 29).

Bistorta bistortoides (Pursh) Small, Bull. Torr. Club 33: 57. 1906; (17, 20, 24, 26).

5. *Polygonum Newberryi* Small, Bull. Torr. Club 21: 170. 1894; (1, 5, 12, 16).

6. *Polygonum shastense* Brewer, Proc. Am. Acad. 8: 400. 1873; (1, 11, 12, 21, 25).

CHENOPODIACEAE. Goosefoot Family

1. *Chenopodium* L.

1. *Chenopodium album* L., Sp. Pl. 1: 219. 1753; (1, 2, 4, 5, 8, 10, 11, 13, 15, 16, 17, 22, 24, 25, 26, 29, 31).

PORTULACACEAE. Purslane Family

Capsule circumscissile. ---- 1. *Lewisia.*
Capsule not circumscissile.
  Style 2-branched. Capsule 2-valved. Sepals scarious. ---- 2. *Spraguea.*
  Style 3-branched. Capsule 3-valved. Sepals not scarious.
    Capsule zygomorphic. Styles short, cleft nearly to base. ---- 3. *Montia.*
    Capsule regular. Styles elongated, united nearly to top. ---- 4. *Claytonia.*

1. *Lewisia* Pursh

1. *Lewisia triphylla* (Wats.) Robinson in Gray, Syn. Fl. 1: 269. 1897; (1, 5, 11, 12, 13, 21, 25).

2. *Spraguea* Torr.

Basal leaves 1-4 inches long. ----------1. *S. umbellata.*
Basal leaves 4-20 mm. long. Low alpine plant. ----------2. *S. umbellata* var.

1. *Spraguea umbellata* Torr., Pl. Fre. 4. in Smiths. Contrib. to Knowl. 5: art. 1. 1850; (1, 11, 14, 18, 21, 24, 26).

Calyptridium umbellatum (Torr.) Greene, Bull. Torr. Club 13: 144. 1886; (10, 25).

2. *Spraguea umbellata* Torr. var. *caudicifera* Gray, Syn. Fl. 1: 278. 1895; (11, 21).

Spraguea multiceps Howell, Erythea 1: 39. 1893; (1, 2, 5, 8, 16, 20).

Calyptridium umbellatum (Torr.) Greene, var. *caudicifera* (Gray) Jepson, Man. Fl. Pl. Calif. 344. 1925; (25).

3. *Montia* L.

1. *Montia sibirica* (L.) Howell, Erythea 1: 39. 1893; (1, 5, 7, 10, 12, 15, 16, 24, 25, 29).

Limnia sibirica (L.) Haw., Syn. Pl. Succ. 11. 1812; (20).

4. *Claytonia* L.

1. *Claytonia lanceolata* Pursh, Fl. Am. Sept. 1: 175. 1814; (1, 2, 5, 6, 7, 8, 12, 13, 14, 15, 16, 17, 20, 21, 22, 25, 26, 27).

Caryophyllaceae. Pink Family

Sepals united into a cup or tube. Petals always present, with slender claws. 1. *Silene.*
Sepals distinct or nearly so. Petals none or without claws.
  Stipules none.
    Styles either fewer than the sepals or else as many and opposite them.
      Petals none or entire or merely emarginate. ----------2. *Arenaria.*
      Petals none or deeply divided into 2 lobes. ----------3. *Stellaria.*
    Styles as many as the sepals and alternate with them. ----------4. *Sagina.*
  Stipules present, scarious. ----------5. *Spergularia.*

1. *Silene* L.

Petals 2-lobed. ----------1. *S. Douglasii* var.
Petals 2-parted, each part again 2-lobed. ----------2. *S. montana* var.

1. *Silene Douglasii* Hook. var. *multicaulis* (Nutt.) Robinson, Proc. Am. Acad. 28: 144. 1893; (5, 15).

Silene multicaulis Nutt. in Torr. & Gray, Fl. N. Am. 1: 192. 1838; (1, 2, 8, 20, 22).

2. *Silene montana* Wats. var. *viscida* Henderson, Rhodora 32: 25. 1930. The varietal form resembles the species in all ways except that it is glandular above.

2. *Arenaria* L.

Leaves lanceolate. ----------1. *A. macrophylla.*
Leaves linear, almost needle-like. ----------2. *A. pumicola.*

1. *Arenaria macrophylla* Hook., Fl. Bor. Am. 1: 102. pl. 37. 1830; (1, 10, 15, 25, 29).

Moehringia macrophylla (Hook.) Torr. in Wilkes, U. S. Exped. 17: 246. 1874; (5, 16, 17, 20, 24, 26, 31).

2. *Arenaria pumicola* Cov. & Leiberg, Proc. Biol. Soc. Wash. 11: 169. 1897.

This species is so close to *A. aculeata* Wats. that it can be separated from it only with difficulty. Crater Lake specimens have more erect leaves which are either blunt or very short-pointed. The nerves of the calyx are less pronounced in our plant than in typical *A. aculeata* Wats.

3. *Stellaria* L.

Bracts of the inflorescence small and scarious.
- Leaves linear, acute at each end. ---- 1. *S. longifolia.*
- Leaves ovate, not at all linear. ---- 2. *S. umbellata.*

Bracts of the inflorescence leafy.
- Leaves lanceolate. ---- 3. *S. calycantha.*
- Leaves ovate. ---- 4. *S. crispa.*

1. *Stellaria longifolia* Muhl. in Willd., Enum. Hort. Berol. 479. 1809; (12, 15, 16, 27).

Alsine longifolia (Muhl.) Britton, Mem. Torr. Club 5: 150. 1894; (1, 2, 5, 8, 13, 17, 20, 24, 31).

2. *Stellaria umbellata* Turcz., Bull. Soc. Nat. Mosc. 89. 1838; (11, 15, 21, 22, 25).

Alsine umbellata Lamb., Fl. Fr. 3: 45. 1778; (8, 12).

3. *Stellaria calycantha* Bong., Mem. Acad. St. Petersb. VI. 2: 127. 1832; (15).

Alsine calycantha (Ledeb.) Rydb., Bull. Torr. Bot. Club 24: 244. 1897; (2, 5, 20, 26).

Alsine simcoei Howell, Fl. N. W. Am. 83. 1897; (1).

Some writers refer this species to *A. borealis*, but we follow Gray and also Macoun in restoring it to specific rank. Specimens previously reported as *A. borealis* from Crater Lake Park should be referred to *A. calycantha.*

4. *Stellaria crispa* Cham. & Schlecht., Linnaea 1: 51. 1826; (7, 11, 12, 15, 16, 21, 22).

Alsine crispa (Cham. & Schlecht.) Holtz., Contr. U. S. Nat. Herb. 3: 216. 1895; (1, 2, 5, 13, 20, 24, 26).

4. *Sagina* L.

1. *Sagina Linnaei* Presl, Rel. Haenk. 2: 14. 1831; (11, 21, 24, 25).

Sagina saginoides (L.) Britton, Mem. Torr. Bot. Club 5: 151. 1894. (5, 6, 8, 15, 17, 22, 25, 27, 31).

5. *Spergularia* Presl.

1. *Spergularia rubra* (L.) J. & C. Presl var. *perennans* (Kindb.) Robinson, in Gray, Syn. Fl. 1: 250. 1897.

Tissa rubra (L.) Britton var. *perennans* (Kindb.) Greene, Pittonia 2:229. 1892; (2, 10, 25).

Greene states that this is an indigenous species. He says, "From the peculiar character of the soil, and other considerations, I can not doubt that this plant is indigenous at San Francisco. This view is confirmed by my having this year collected the same plant, upon similar ground, in Knight's Valley at the western base of Mt. St. Helena; and still later Mr. Jepson

brings it from lower Sacramento." Jepson, on the other hand, thinks that it is a native of Europe.

RANUNCULACEAE. Buttercup Family

Carpels numerous, at least more than 5, 1-ovuled. Fruit an achene.
- Cauline leaves three in a whorl.
  - Styles short, glabrous or pubescent. ---- 1. *Anemone*.
  - Styles long, plumose. ---- 2. *Pulsatilla*.
- Cauline leaves alternate or none.
  - Petals none. ---- 3. *Thalictrum*.
  - Petals present. ---- 4. *Ranunculus*.

Carpels few, 2-many-ovuled. Fruit a follicle.
- Flowers irregular.
  - Upper sepal spurred. Petals 5. ---- 5. *Delphinium*.
  - Upper sepal hood-like. Petals 2. ---- 6. *Aconitum*.
- Flowers regular.
  - Sepals spurred. Petals present. ---- 7. *Aquilegia*.
  - Sepals not spurred. Petals none.
    - Leaves simple. ---- 8. *Caltha*.
    - Leaves compound. ---- 9. *Actaea*.

1. *Anemone* L.

Flowers white.
- Leaves dissected. ---- 1. *A. Drummondii*.
- Leaves not dissected. Stem leaves simple. ---- 2. *A. deltoides*.

Flowers pink to blue. Stem leaves 3-5 foliate. ---- 3. *A. quinquefolia* var.

1. *Anemone Drummondii* Wats., Bot. Cal. 2: 424. 1880; (1, 4, 5, 6, 12, 15, 16, 20, 21).

2. *Anemone deltoidea* Dougl. in Hook., Fl. Bor. Am. 1: 6. 1829; (1, 5, 7, 10, 12, 14, 15, 16, 25, 29).

3. *Anemone quinquefolia* L. var. *Lyallii* (Britton) Robinson in Gray, Syn. Fl. 1: 13. 1895; (12).

Anemone Lyallii Britton, Ann. N. Y. Acad. Sci. 6: 227. 1891; (1, 5, 16).

2. *Pulsatilla* Adans.

1. *Pulsatilla occidentalis* (Wats.) Freyn., Deutsch. Bot. Monatssch. 8: 78. 1890; (2, 5, 6, 12, 16, 20, 22).

Anemone occidentalis Wats., Proc. Am. Acad. 11: 121. 1876; (1, 2, 4, 7, 22).

3. *Thalictrum* L.

1. *Thalictrum sparsiflorum* Turcz. in Fisch. & Mey., Ind. Sem. Hort. Petrop. 1: 40. 1835; (1, 2, 7, 8, 12, 15, 20, 21, 24, 25, 26, 31).

4. *Ranunculus* L.

Petals white. Submerged plant. ---- 1. *R. trichophyllus*.

Petals yellow. Plants not submerged.
- Leaves entire, or slightly dentate. Plants low, with creeping stems. 2. *R. Gormani*.
- Leaves or some of them lobed or yet more deeply separated into segments.
  - Plants glabrous or nearly so, 3 dm. or less high. ---- 3. *R. Eschscholtzii*.
  - Plants pubescent or hairy, usually more than 3 dm. high. ---- 4. *R. occidentalis* var.

1. *Ranunculus trichophyllus* Chaix., in Vill., Hist. Pl. Dauph. 1: 335. 1786; (19).

Ranunculus aquatilis L. var. *caespitosus* DC., Prodr. 1: 26. 1824; (5).

Batrachium trichophyllum (Chaix) Bosch, Prodr. Fl. Bat. 5. 1850; (1, 2, 6, 8, 17, 20, 26, 31).

Ranunculus acquatilis L. var. *trichophyllus* (Chaix) Gray, Man. ed. 5. 40. 1867; (15, 25).

Batrachium aquatile (L.) Wimm. var. *trichophyllum* (Chaix) Gray, Proc. Am. Acad. 21: 363. 1886; (24).

Batrachium aquatile (L.) Wimm. var. *pantothrix* (Brot.) Piper, Contr. U. S. Nat. Herb. 11: 270. 1906; (13, 16).

Batrachium aquatile (L.) Wimm. var. *caespitosum* (DC.) Piper, Contr. U. S. Nat. Herb. 11: 270. 1906; (13).

Western species of the section *Batrachium* of *Ranunculus* are in a confused taxonomic state. For a recent treatment, see Drew, Rhodora 38: 1-47. 1936. According to Drew's treatment, Crater Lake specimens would be referred to *R. trichophyllus* Chaix var. *hispidulus* (Drew) Drew, Rhodora 38: 29. 1936.

2. *Ranunculus Gormani* Greene, Pitt. 3: 91. 1896; (1, 12).

3. *Ranunculus Eschscholtzii* Schlect., Animad. Ranunc. 2: 16. 1820; (1, 4, 5, 6, 12, 13, 15, 16, 20, 21, 24, 26).

4. *Ranunculus occidentalis* Nutt. var. *dissectus* Henderson, Rhodora 32: 25. 1930.

The narrowly dissected leaves characterize this variety.

5. *Delphinium* L.

Stems tall, 2½-6 feet high ---------- 1. *D. scopulorum* var.
Stems low, 5-15 inches high. ---------- 2. *D. pauciflorum* var.

1. *Delphinium scopulorum* Gray var. *glaucum* (Wats.) Gray, Bot. Gaz. 12: 52. 1887; (5, 24, 25).

Delphinium glaucum Wats., Bot. Cal. 2: 427. 1880; (1, 2, 11, 15, 16, 21, 26).

Crater Lake specimens are intermediate between the varieties *glaucum* and *alpinum*. The varieties of *D. scopulorum* grade into each other and into the species, making individual specimens difficult to place. The specimens examined came from the swampy canyon of North Castle Creek, near the western boundary of the Park. They have nearly glabrous pedicels, the petals with the blade split halfway, and subglaucous leaves. On the other hand, they have ovaries which are almost villous, deep blue flowers, and sepals over ½ inch in length.

2. *Delphinium pauciflorum* Nutt. var. *depauperatum* (Nutt.) Gray, Bot. Gaz. 12: 54. 1887.

Delphinium depauperatum Nutt. in Torr. & Gray, Fl. N. Am. 1: 33. 1838; (1, 5, 12, 13, 22, 26).

6. *Aconitum* L.

1. *Aconitum columbianum* Nutt. in Torr. & Gray, Fl. N. Am. 1: 34. 1838; (1, 2, 5, 7, 8, 11, 12, 13, 14, 15, 18, 20, 21, 25, 26, 28).

7. *Aquilegia* L.

1. *Aquilegia formosa* Fisch. in DC. Prod., 1: 50. 1824; (1, 2, 5, 6, 7, 12, 13, 15, 16, 17, 20, 21, 25, 26, 29).

8. *Caltha* L.

1. *Caltha biflora* DC. Syst. 1: 310. 1818; (1, 5, 10, 11, 12, 15, 16, 26, 29).

9. *Actaea* L.

1. *Actaea spicata* L. var. *arguta* (Nutt.) Torr., Pac. R. R. Rep. 4: 63. 1856; (4, 5, 11, 13, 16, 21, 25, 29).

Actaea arguta Nutt. in Torr. & Gray, Fl. N. Am. 1: 35. 1838; (1, 2, 6, 7, 8, 12, 14, 16, 20, 24, 26, 27, 31).

Actaea rubra (Ait.) Willd. var. *arguta* (Nutt.) Lawson, Trans. Royal Soc. Canada 2(4): 84. 1884; (10).

BERBERIDACEAE. Barberry Family

Shrubs. Leaves evergreen, pinnate, spiny. ----------1. *Berberis.*
Herbs. Leaves deciduous, not pinnate nor spiny.
Leaves ternately compound. Flowers in panicles. ----------2. *Vancouveria.*
Leaves 3-parted. Flowers in spikes. ----------3. *Achlys.*

1. *Berberis* L.

1. *Berberis nervosa* Pursh, Fl. Am. Sept. 1: 219. 1814; (1, 5, 10, 12, 13, 15, 16, 18, 25, 29).

Mahonia nervosa (Pursh) Nutt., Gen. Am. 1: 212. 1818; (30).

Odostemon nervosus (Pursh) Rydb., Bull. Torr. Bot. Club. 33: 141. 1906; (20).

2. *Vancouveria* Morr. & Dec.

1. *Vancouveria hexandra* (Hook.) Morr. & Dec., Ann. Sci. Nat. II. 2: 351. 1834; (1, 5, 7, 10, 12, 15, 16, 25, 29).

3. *Achlys* DC.

1. *Achlys triphylla* (Smith) DC., Syst. 2: 35. 1821; (1, 5, 7, 10, 12, 14, 15, 16, 25, 29)

FUMARIACEAE. Fumitory Family

1. *Dicentra* Bernh.

Inflorescence thrysoid. Plants over 6 inches high. ----------1. *D. formosa.*
Inflorescence of solitary flowers. Plants low, less than 6 inches high. ---2. *D. uniflora.*

1. *Dicentra formosa* (Andr.) Walp., Rep. Bot. Syst. 1: 118. 1842; (1, 4, 5, 9, 10, 12, 14, 15, 18, 20, 21, 25, 26, 28, 29).

Bicuculla formosa (Andr.) Coville, Contri. U. S. Nat. Herb. 4: 60. 1893; (1, 5, 14, 16).

2. *Dicentra uniflora* Kellogg, Proc. Cal. Acad. Sci. 4: 141. 1870; (8, 10, 12, 15, 21, 25, 27).

Bicuculla uniflora (Kellogg) Howell, Fl. N. West Am. 34. 1897; (1).

CRUCIFERAE. Mustard Family

Siliques compressed parallel to the broad partition
Valves nerveless. Leaves all petioled. ----------1. *Cardamine.*

Valves 1-nerved. Cauline leaves sessile.
Siliques lanceolate, the valves reticulate. ----------2. *Parrya.*
Siliques linear. ----------3. *Arabis.*
Siliques terete, not at all compressed.
Valves of the pod nerveless. ----------4. *Roripa.*
Valves of the pod nerved. ----------5. *Barbarea.*

1. *Cardamine* L.

Leaves all simple. ----------1. *C. bellidifolia* var.
Leaves, or some of them, pinnate.
Capsules 8-20 seeded. Leaflets mostly roundish. ----------2. *C. oligosperma.*
Capsules 20-30 seeded. Leaflets mostly oblong. ----------3. *C. pennsylvanica.*

1. *Cardamine bellidifolia* L. var. *pachyphylla* Leiberg, Proc. Biol. Soc. Wash. 11: 170. 1897.

2. *Cardamine oligosperma* Nutt. in Torr. & Gray, Fl. N. Am. 1: 85. 1838; (1, 2, 5, 7, 10, 12, 13, 15, 16, 20, 24, 25, 29).

3. *Cardamine pennsylvanica* Muhl. in Willd., Sp. Pl. 3: 486. 1800; (1, 2, 5, 6, 8, 11, 12, 15, 16, 20, 22, 25, 26, 29, 31).

2. *Parrya* R. Br.

1. *Parrya Menziesii* (Hook.) Greene, Fl. Fran. 253. 1891; (1, 5, 12, 21, 25, 26).

Phoenicaulis cheiranthoides Nutt. in Torr. & Gray, Fl. N. Am. 1: 89. 1838. (20).

3. *Arabis* L.

Pods reflexed or recurved, at least not erect nor spreading at maturity.
Plant finely stellate-pubescent, almost hoary. Pods often arcuate. 1. *A. Holboellii.*
Plant not densely and finely pubescent. Pods mostly straight.
Pods very narrow, 1.5-2 mm. wide, sometimes slightly arcuate 2. *A. Wyndii.*
Pods wider, usually about 3 mm. wide. ----------3. *A. suffrutescens.*
Pods erect, at most merely spreading, but never definitely reflexed.
Plants hoary, at least the basal leaves and lower part of the stem. 4. *A. Lemmoni.*
Plants glabrous or hairy but never hoary.
Pods wide, normally over 3 mm. wide. ----------5. *A. platysperma.*
Pods narrower, less than 3 mm. wide.
Leaves tufted at the base. Pods 1-2 inches long.---------- 6. *A. Lyallii.*
Leaves well scattered up the stem, not conspicuously tufted at the base. Pods 1½-4 inches long. ----------7. *A. Drummondii.*

1. *Arabis Holboellii* Hornem., Fl. Dan. t. 1879. 1827; (2, 4, 5, 6, 11, 13, 15, 21, 25, 26, 27).

Arabis retrofracta R. Grah., Edinb. New Phil. Journ. 344. 1829; (1, 20).

The pods of the specimens from Crater Lake are usually distinctly arcuate although some specimens have straight pods.

2. *Arabis Wyndii* Henderson, Rhodora 32: 25. 1930.

Arabis Holboellii Hornem., Fl. Dan. 2: 5. pl. 1879. 1827, of western authors.

Arabis hastulata Greene, Leaflets Bot. Obs. & Crit. 2: 79. 1910, of western authors.

3. *Arabis suffrutescens* Wats. Proc. Am. Acad. 17: 362. 1882; (1, 5, 20, 25, 26).

It is probable that *A. dianthifolia* Greene is merely a variant of *A. suffrutescens* Wats.

4. *Arabis Lemmoni* Wats., Proc. Am. Acad. 22: 467. 1887; (1, 2, 8, 11, 15, 20, 21, 25, 26).

Arabis latifolia (Wats.) Piper, Contrib. U. S. Nat. Herb. 11: 295. 1906; (5).

5. *Arabis platysperma* Gray, Proc. Am. Acad. 6: 519. 1865; (1, 11, 16, 21, 24, 25).

6. *Arabis Lyallii* Wats., Proc. Am. Acad. 11: 122. 1876; (1, 2, 5, 6, 8, 11, 13, 15, 20, 21, 22, 26).

Arabis Drummondii Gray var. *Lyallii* Jepson, Man. Fl. Pl. Calif. 429. 1925; (25).

A. Gray, in his original description stated, "Resembling some forms of *A. Drummondii*, but distinguished by its perennial root." Greene described a slightly variant form from Mt. Thielsen as *A. multiceps*.

7. *Arabis Drummondii* Gray, Proc. Am. Acad. 6: 187. 1864; (2, 4, 5, 6, 8, 15, 16, 20, 21, 22, 25, 26).

4. *Roripa* Scop.

1. *Roripa curvisiliqua* (Hook.) Bessey, Mem. Torr. Club 5: 169. 1894; (1, 2, 5, 7, 8, 12).

Nasturtium curvisiliqua (Hook.) Nutt. in Torr. & Gray, Fl. N. Am. 1: 73. 1838; (10).

Radicula curvisiliqua (Hook.) Greene, Leaflets, 1: 113. 1905; (11, 13, 15, 16, 19, 20, 22, 24, 25, 26, 29).

5. *Barbarea* R. Br.

1. *Barbarea vulgaris* R. Br. in Ait., Hort. Kew. ed. 2. 4: 109. 1812; (1, 10, 11, 13, 15, 25, 31).

Barbarea barbarea (L.) MacMillan, Metasp. Minn. 259. 1892; (19).

Campe barbarea (L.) W. F. Wright in Piper, Contri. U. S. Nat. Herb. 11: 303. 1906; (5, 13, 24).

DROSERACEAE. Sundew Family

1. *Drosera* L.

Leaf-blades orbicular. ----------1. *D. rotundifolia.*

Leaf-blades spatulate, at least plainly 2 or 3 times as long as broad. 2. *D. longifolia.*

1. *Drosera rotundifolia* L., Sp. Pl. 282. 1753; (1, 2, 5, 11, 12, 15, 16, 20, 21, 25, 26, 29, 31).

2. *Drosera longifolia* L., Sp. Pl. 282. 1753; (5, 15, 20, 25, 26, 29, 31).

Drosera anglica Huds., Fl. Angl. 135. 1778; (1, 12, 16, 21).

CRASSULACEAE. Stonecrop Family

Petals commonly spreading, at least at the tip. Mostly mat-like plants with branching rootstocks. Petals distinct. ----------1. *Sedum.*

Petals commonly erect, often closely approximate at the tip. Coarse plants with thick basal leaf rosettes borne on a simple or branched caudex. Petals somewhat united. ----------2. *Cotyledon.*

1. *Sedum* L.

1. *Sedum spathulifolium* Hook., Fl. Bor. Am. 1: 227. 1834; (1, 5, 10, 12, 16, 18, 25, 29).

2. *Cotyledon* (Tourn.) L.

1. *Cotyledon oregonensis* Watson, Proc. Am. Acad. 17: 373. 1882; (1).

SAXIFRAGACEAE. Saxifrage Family

Plants with woody stems. ---------- 1. *Ribes.*

Plants not with woody stems.

Ovary 2-celled and placentae axile, or carpels 2 and distinct. ---------- 2. *Saxifraga.*

Ovary 1-celled with 2 parietal placentae.

Stamens 10.

Petals entire, almost filiform. Capsule early and unequally 2-valved to the base. ---------- 3. *Tiarella.*

Petals usually laciniate or toothed. Capsule equally 2-valved.

Petals white or pink, clawed. Styles 3. ---------- 4. *Lithophragma.*

Petals red, sessile. Styles 2. ---------- 5. *Tellima.*

Stamens 5. Petals cleft or pinnatifid. ---------- 6. *Mitella.*

1. *Ribes* L.

Stems unarmed. Berry spineless. Peduncles bearing a several to many-flowered raceme.

Plants trailing on the ground. ---------- 1. *R. erythrocarpum.*

Plants erect.

Calyx-tube cylindric, 2½-3 times as broad as long. Berry crimson. ---------- 2. *R. cereum.*

Calyx-tube campanulate, 1 to nearly 2 times as long as broad. Berry black.

Fruit viscid, pubescent. ---------- 3. *R. viscosissimum.*

Fruit smooth. ---------- 4. *R. viscosissimum* var.

Stems bearing spines at the nodes below the leaves and often prickly. Peduncles mostly 1 to few flowered.

Calyx-tube rotately spreading or saucer-shaped. ---------- 5. *R. lacustre.*

Calyx-tube cylindric or companulate.

Stamens scarcely exceeding the petals. Calyx greenish-white. ---------- 6. *R. binominatum.*

Stamens twice as long as the petals. Calyx crimson or red. ---------- 7. *R. Lobbii.*

1. *Ribes erythrocarpum* Cov. & Leib., Proc. Biol. Soc. Wash. 10: 132. 1896; (1, 12, 30).

2. *Ribes cereum* Dougl., Trans. Hort. Soc. Lond. 7: 512. 1830; (1, 2, 5, 7, 8, 11, 12, 13, 15, 16, 19, 20, 21, 24, 25, 26, 27, 30).

3. *Ribes viscosissimum* Pursh, Fl. Am. Sept. 1: 163. 1814; (1, 2, 5, 7, 8, 11, 12, 13, 15, 16, 21, 22, 25, 27, 30).

4. *Ribes viscosissimum* Pursh var. *Hallii* Jancz., Mem. Soc. Geneve 35: 328. 1907; (21, 25).

Ribes Hallii Jancz., Bull., Intern. Acad. Sci. Cracovie 9. 1907; (26, 30).

We have not collected this variety but F. P. Sipe, of the University of Oregon is certain that he has seen authentic material growing within the Park boundaries. Intergrading forms connect the variety with the species.

5. *Ribes lacustre* (Pers.) Poir, Encyl. Suppl. 2: 856. 1811; (1, 5, 6, 12, 13, 15, 16, 22, 25, 26, 29, 30).

Limnobotrya lacustris (Pers.) Rydb., Fl. Rocky Mts. 396. 1917; (20, 31).

6. *Ribes binominatum* Hell., Cat. N. Am. Pl. ed. 2. 5. 1900; (12, 25).

Grossularia binominata (Hell.) Cov. & Britt., N. Am. Fl. 22: 218. 1908; (30).

Ribes ambiguum Wats., Proc. Am. Acad. 18: 193. 1883; (1).

7. *Ribes Lobbii* Gray, Am. Nat. 10: 274. 1876; (1, 5, 12, 15, 16, 25).

Grossularia Lobbii (Gray) Cov. & Britt., N. Am. Fl. 22: 217. 1908; (30).

2. *Saxifraga* L.

Stems densely beset with small leaves about ¼ inch long. ——1. *S. Tolmiei.*
Stems not densely beset with small leaves.
  Leaves purplish. Root bulblet-bearing. ——2. *S. nivalis.*
  Leaves not purplish. Root not bulblet-bearing.
    Leaves serrate or coarsely dentate. Inflorescence loose. —3. *S. ferruginea* var.
    Leaves entire or nearly so. Inflorescence congested, almost headlike especially when young. ——4. *S. integrifolia.*

1. *Saxifraga Tolmiei* Torr. & Gray, Fl. N. Am. 1: 567. 1840; (1, 5, 10, 11, 15, 16, 25).

2. *Saxifraga nivalis* L., Sp. Pl. 401. 1753; (2, 4, 11, 15, 25).

Micranthes rhomboidea Small, N. Am. Fl. 22: 136. 1905; (20).

3. *Saxifraga ferruginea* Grah. var. *Macounii* Engl. &. Irmsch., Pflanzenreich Heft 67: 70. 1916.

Saxifraga Bongardi Presl., Zool. Bot. Ges. Vienna, 19: 528. 1869, of western authors in part; (5, 14, 15, 16).

Saxifraga nutkana Moc. in Small, Bull. Torr. Club 23: 368. 1896, of western authors in part; (1, 2, 4, 14).

Spatularia Brunoniana Small, N. Am. Fl. 22: 149. 1905; (6).

4. *Saxifraga integrifolia* Hook., Fl. Bor. Am. 1: 249. 1834; (1, 2, 5, 11, 16, 25, 29).

3. *Tiarella* L.

1. *Tiarella unifoliata* Hook., Fl. Bor. Am. 1: 238. 1834; (1, 2, 4, 5, 6, 7, 10, 12, 13, 15, 16, 20, 22, 25, 26).

4. *Lithophragma* Nutt.

1. *Lithophragma parviflora* (Hook.) Nutt. in Torr. & Gray, Fl. N. Am. 1: 584. 1840; (1, 2, 6, 7, 12, 20, 22, 25, 26, 29, 31).

Tellima parviflora Hook., Fl. Bor. Am. 1: 239. 1832; (5, 8, 13, 15, 27).

5. *Tellima* R. Br.

1. *Tellima grandiflora* (Pursh) Dougl., Bot. Reg. pl. 1178. 1828; (1, 4, 5, 6, 7, 10, 12, 15, 16, 18, 20, 25, 29).

6. *Mitella* (Tourn.) L.

Stem bearing 1-3 leaves. ——1. *M. caulescens.*
Stem leafless.
  Petals mostly 3-cleft at the apex. ——2. *M. trifida.*
  Petals pinnately 3-5 parted.
    Stamens opposite the petals. ——3. *M. pentandra.*
    Stamens alternate with the petals. ——4. *M. Breweri.*

1. *Mitella caulescens* Nutt. in Torr. & Gray, Fl. N. Am. 1: 586. 1840; (5, 12, 13, 15, 16, 26, 29).

Mitellastra caulescens (Nutt.) Howell, Fl. N. West Am. 201. 1898; (1, 20).

2. *Mitella trifida* Graham, Edinb. New Phil. Jour. 185. 1829; (1, 2, 5, 12, 15, 16, 21, 25).

Ozomelis trifida (Graham) Rydb., N. Am. Fl. 22: 95. 1905; (20).

This is an extremely variable species, especially in the characters of the leaves.

3. *Mitella pentandra* Hook., Bot. Mag. pl. 2933. 1829; (1, 2, 5, 8, 12, 13, 15, 16, 21, 22, 25, 26).

Pectianthia pentandra (Hook.) Rydb., N. Am. Fl. 22: 93. 1905; (6, 20).

4. *Mitella Breweri* Gray, Proc. Am. Acad. 6: 533. 1865; (1, 2, 4, 5, 10, 11, 12, 15, 16, 21, 22, 25, 26).

Pectianthia Breweri (Gray) Rydb., N. Am. Fl. 22: 93. 1905; (6, 20).

ROSACEAE. Rose Family

Ovary superior
- Fruit dehiscent, consisting of 2-5 dry pods or follicles.
  - Stamens distinct.
    - Stamens well exserted. Flowers mostly rose-color. ——— 1. *Spiraea.*
    - Stamens scarcely exserted. Flowers creamy white. ——— 2. *Holodiscus.*
  - Stamens united at base. Leaves disected. ——— 3. *Eriogynia.*
- Fruit indehiscent.
  - Ovary becoming an akene (druplet in Rubus). Herbs or shrubs.
    - Pistils only one. Leaves cuneate and 3-toothed. ——— 4. *Purshia.*
    - Pistils more than one. Leaves compound or pinnately lobed.
      - Pistils becoming druplets which are coherent on a convex receptacle and form a berry-like fruit. ——— 5. *Rubus.*
      - Pistils becoming dry akenes.
        - Pistils borne on a flat or convex receptacle.
          - Style deciduous from the akene. Receptacle conic.
            - Receptacles fleshy. Leaves 3-foliate. ——— 6. *Fragaria.*
            - Receptacles dry. Leaves pinnate or palmate. ——— 7. *Potentilla.*
          - Style persistent on the akene. ——— 8. *Geum.*
        - Pistils disposed on the inside of a globose calyx-tube.
          - Stems prickly. ——— 9. *Rosa.*
  - Ovary becoming a drupe. Trees with simple leaves. ——— 10. *Prunus.*

Ovary inferior, 2-5 celled.
- Leaves compound. Flowers in compound corymbs. ——— 11. *Sorbus.*
- Leaves simple. Flowers not borne as above. ——— 12. *Amelanchier.*

1. *Spiraea* L.

1. *Spiraea densiflora* Nutt. in Torr. & Gray, Fl. N. Am. 1: 414. 1840; (2, 5, 6, 8, 11, 12, 15, 16, 20, 21, 22, 25, 28, 30, 31).

Spiraea arbuscula Greene, Erythea, 3: 63. 1895; (1).

2. *Holodiscus* Maxim.

1. *Holodiscus discolor* Maxim. var. *glabrescens* (Heller) Jepson, Man. Fl. Pl. Calif. 479. 1925; (25).

Holodiscus glabrescens Heller, Muhlenbergia 1: 40. 1904; (12).
Sericotheca glabrescens (Heller) Rydb., N. Am. Fl. 22: 265. 1908; (20, 26, 30).

3. *Eriogynia* Hook.

1. *Eriogynia pectinata* (Pursh) Hook., Fl. Bor. Am. 1: 255. 1834.

Luetkea sibbaldioides Bong., Mem. Acad. St. Petersb. VI. 2: 130. 1832; (1).
Luetkea pectinata (Torr. & Gray) Kuntze, Rev. Gen. Pl. 217. 1891; (5, 6, 12, 16, 25).

4. *Purshia* DC.

1. *Purshia tridentata* (Pursh) DC., Trans. Linn. Soc. 12: 158. 1817; (3, 8, 15, 20, 25, 26, 27, 30).

Kunzia tridentata (Pursh) Spreng., Syst., 2: 475. 1825; (1, 2, 5, 7, 12).

5. *Rubus* L.

Leaves 3-5 lobed or rarely 3-5 parted.
Stems erect. Leaves 10-30 cm. long. ---------- 1. *R. parviflorus.*
Stems trailing. Leaves 2½-7½ cm. long. ---------- 2. *R. lasiococcus.*
Leaves 3-5 foliate.
Stems trailing. Carpels not separating from the receptacle in fruit. 3. *R. ursinus.*
Stems erect or ascending, but the long branches sometimes somewhat trailing.
Carpels separable from the receptacle in fruit. ---------- 4. *R. leucodermis.*

1. *Rubus parviflorus* Nutt., Gen. Am. 1: 308. 1818; (1, 2, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 19, 21, 22, 25, 26, 27, 29).

Rubacer parviflorum (Nutt.) Rydb., Bull. Torr. Bot. Club 30:274. 1903; (17, 30).

2. *Rubus lasiococcus* Gray, Proc. Am. Acad. 17: 201. 1882; (1, 5, 7, 12, 15, 16).

3. *Rubus ursinus* Cham. & Schlecht., Linnaea 2: 11. 1827; (1, 7, 10, 12).

4. *Rubus leucodermis* Dougl. in Torr. & Gray, Fl. N. Am. 1: 454. 1840; (1, 2, 5, 7, 10, 11, 12, 13, 15, 16, 19, 20, 22, 25, 26, 27, 29, 30).

6. *Fragaria* L.

1. *Fragaria virginiana* Duch. var. *Grayana* Rydb., Mem. Dept. Bot. Columbia Univ. 2: 180. 1898.

Fragaria Grayana Vilmorin in Gay, Ann. Sci. Nat. IV. 8: 202. 1857; (31).

7. *Potentilla* L.

Leaves pinnate, with 5 or more leaflets. ---------- 1. *P. glandulosa.*
Leaves palmate, with 3-7 leaflets.
Leaflets oblanceolate to obovate. ---------- 2. *P. gracilis* var.
Leaflets broadly obovate. Leaves with three leaflets. ---------- 3. *P. flabellifolia.*

1. *Potentilla glandulosa* Lindl., Bot. Reg. 19. pl. 1583. 1833; (1, 10, 11, 15, 18, 25, 27).

Drymocallis glandulosa (Lindl.) Rydb., Mem. Columbia Univ. Dept. of Bot. 2: 198. 1898; (2, 5, 8, 16, 17, 19, 20, 22, 26, 31).

2. *Potentilla gracilis* Dougl. var. *Blaschkeana* (Turcz.) Jepson, Man. Fl. Pl. Calif. 489. 1925; (25).

Potentilla Blaschkeana Turcz. in Lehm., Ind. Sem. Hort. Hamb. 9. 1853; (2, 5, 20, 22, 26).

The varietal form differs in its stouter habit, ascending branches, larger flowers, and broader leaflets. Also the leaflets are obovate and more deeply toothed.

3. *Potentilla flabellifolia* Hook. in Torr. & Gray, Fl. N. Am. 1: 442. 1840; (1, 5, 11, 15, 16, 20, 21, 25, 26, 31).

8. *Geum* L.

1. *Geum macrophyllum* Willd., Enum. Hort. Berol. 557. 1809; (1, 4, 5, 6 ,7, 8, 11, 12, 13, 15, 16, 20, 21, 22, 24, 25, 27, 29, 31).

9. *Rosa* (Tourn.) L.

1. *Rosa gymnocarpa* Nutt. in Torr. & Gray, Fl. N. Am. 1: 461. 1840; (1, 2, 5, 7, 8, 10, 12, 13, 15, 16, 18, 20, 22, 25, 26, 28, 29, 30).

10. *Prunus* L.

1. *Prunus emarginata* (Dougl.) Walp., Rep. 2: 9. 1843; (2, 3, 5, 9, 10, 11, 12, 13, 15, 19, 20, 21, 25, 26, 30).

11. *Sorbus* L.

1. *Sorbus sitchensis* Roem., Syn. Rosif. 3: 139. 1847; (12, 22, 25, 30).
Pyrus sitchensis (Roem.) Piper, Mazama 2: 107. 1901; (5, 15, 16).
Sorbus angustifolia Rydb., Fl. Rky. Mts. 448. 1917; (20).

At Crater Lake there are two forms of this species; one having ovate and one having much narrower leaflets. The narrow-leaflet form has been described by Rydberg as *S. angustifolia*. The leaflet shape of this genus is so variable that both broad and narrow forms are here united. *S. angustifolia* might very reasonably be considered a variety of *S. sitchensis*. The Pacific Coast plants have been called *S. sambucifolia*. This name, however, cannot be applied to a species of the United States as true *S. sambucifolia* is a plant of eastern Asia and occurs in North America only in Alaska, if at all. *S. sitchensis* is used for our plant by Piper, and also by Hedlund's monograph of the genus (1919). Schneider, in his "Handbuch der Laubholzkunde," refers *S. sitchensis* to *S. occidentalis*. Rydberg follows Schneider in not recognizing *S. sitchensis*, but differs in taking up the *S. scopulina* of Greene for this plant. It is not probable that *S. occidentalis* is the same as *S. sitchensis*, as the latter was based on a specimen of Bongard collected at Sitka, and the former has not yet been reported from Alaska.

12. *Amelanchier* Medic.

1. *Amelanchier florida* Lindl., Bot. Reg. 19: pl. 1589. 1833; (1, 2, 5, 13, 15, 16, 20, 27, 30).

Some botanists have called the specimens from Crater Lake *A. basalticola* Piper. The classification followed in the present work is that furnished by the Gray Herbarium.

LEGUMINOSAE. Pea Family

Leaves palmate with 5-15 leaflets. ----------1. *Lupinus.*
Leaves palmate or pinnate, but if palmate with but 3 leaflets.
Plants usually with tendrils. Leaves abruptly pinnate.
Leaves palmate or trifoliate. ----------2. *Trifolium.*

Leaves pinnate.
Style filiform, hairy near the tip only. ----------3. *Vicia.*
Style flattened, hairy on the inner side. ----------4. *Lathyrus.*
Plants without tendrils. Leaves odd-pinnate. ----------5. *Hosackia.*

1. *Lupinus* L.

Pedicels short and stout, less than 3 mm. long. Racemes subspicate. Flowers usually crowded.
Racemes capitate or sub-capitate, rarely more than twice as long as wide.
Peduncles usually curved or bent, spreading or decumbent.
Stems usually longer than their peduncles and much branched from axial buds of the season. ----------2. *L. Lyallii* var.
Stems usually not longer than their peduncles, not much branched.
Largest leaflets 8-10 mm. long, densely hairy above.------ 1. *L. Lyallii.*
Largest leaflets 10-20 mm. long, quite greenish above. 3. *L. Lyallii* var.
Racemes cylindric or conoidal, usually more than twice as long as wide.
Peduncles usually erect or ascending.
Peduncles short. Racemes equalling or partly surpassing the foliage. ----------4. *L. aridus.*
Peduncles elongated, raising the racemes above the foliage. 5. *L. aridus* var.
Pedicels slender, usually 3-12 mm. long.
Apex of the banner normally not much reflexed from the upper margin of the wing-petals, its ventral median sulcus deep, including considerable of the wings. Keel not ciliate on the upper edge. ---------- 6. *L. Andersoni.*
Apex of the banner normally well reflexed from the upper margins of the wing-petals, its ventral median sulcus usually shallow, including very little of the wings. Keel ciliate on the upper edge. ----------7. *L. latifolius* var.

1. *Lupinus Lyallii* Gray, Proc. Am. Acad. 7: 334. 1868; (1, 2, 5, 15, 16, 25, 26)

2. *Lupinus Lyallii* Gray var. *fruticulosus* (Greene) C. P. Smith, Bull. Torr. Club 51: 303. 1924.

3. *Lupinus Lyallii* Gray var. *Lobbii* (Gray) C. P. Smith, in Jepson, Man. Fl. Pl. Calif. 525. 1925; (8).

Lupinus Lobbii Gray in Wats., Proc. Am. Acad. 8: 533. 1873; (1, 21, 26).

4. *Lupinus aridus* Dougl. in Lindl., Bot. Reg. 15: pl. 1242. 1829; (1, 5, 16, 20).

5. *Lupinus aridus* Dougl. var. *Torreyi* (Gray) C. P. Smith, Bull. Torr. Club 51: 303. 1924.

Lupinus Torreyi Gray in Wats., Bot. King Expl. Exped. 58. 1871; (25).

6. *Lupinus Andersoni* Wats., King Expl. Exp. 58. 1871; (25, 26).

7. *Lupinus latifolius* Lindl. var. *ligulatus* (Greene) C. P. Smith, Contrib. Dudley Herb. Stanford Univ. 1: 49. 1927.

Lupinus ligulatus Greene, Pittonia 1: 215. 1888; (1).

Lupinus barbatus (Henderson) Heller, Muhlenbergia 8: 61. 1912; (25).

2. *T folium* L.

Flowers pedicellate.
Rachis commonly prolonged above the heads. Stems erect. Peduncles terminal. ----------1. *T. Kingii.*
Rachis not prolonged above the heads. Stems creeping. Peduncles axillary. ----------2. *T. repens.*

Flowers sessile.
Heads long-pedunculate. Stipules foliaceous. Flowers white. _____3. *T. longipes.*
Heads sessile, subtended by the stipules of the upper sessile leaves.
Stipules scarious. Flowers red. _____4. *T. pratense.*

1. *Trifolium Kingii* Wats., Bot. King Explor. Exped. 59. 1871; (1, 20, 21, 25, 26).

2. *Trifolium repens* L., Sp. Pl. 2: 767. 1753; (1, 2, 4, 5, 7, 8, 10, 11, 12, 13, 15, 16, 17, 19, 20, 22, 24, 25, 26, 27, 28, 29, 31).

3. *Trifolium longipes* Nutt. in Torr. & Gray, Fl. N. Am. 1: 314. 1838; (1, 5, 11, 12, 16, 20, 21, 24, 25, 26, 27).

4. *Trifolium pratense* L., Sp. Pl. 768. 1753; (1, 2, 4, 5, 7, 8, 10, 11, 12, 13, 15, 16, 17, 20, 22, 24, 25, 26, 27, 28, 29, 31).

3. *Vicia* L.

1. *Vicia americana* Muhl. in Willd., Sp. Pl. 3: 1096. 1801; (1, 2, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 19, 20, 24, 25, 26, 27, 28, 29, 31).

4. *Lathyrus* L.

1. *Lathyrus nevadensis* Wats., Proc. Am. Acad. 11: 133. 1875; (1, 25, 26).
Lathyrus Nuttallii Wats., Proc. Am. Acad. 21: 450. 1886; (1, 5, 11, 12, 20).

Any point of separation between this species and *L. Nuttallii* seems to break down when followed through a series of specimens. Jepson (Man. Fl. Pl. Calif. 583. 1925) reduces *L. Nuttallii* to the synonymy of *L. nevadensis.*

5. *Hosackia* Dougl.

1. *Hosackia Torreyi* Gray, Proc. Am. Acad. 8: 625. 1873; (11, 18, 24).
Lotus Torreyi (Gray) Greene, Pitt. 2: 146. 1890; (1, 7, 10, 12, 25, 26).
Lotus oblongifolius Greene var. *Torreyi* (Gray) Ottley, Univ. Calif. Publ. Bot. 10: 205. 1923; (25).

CELASTRACEAE. Stafftree Family

1. *Pachistima* Raf.

1. *Pachistima myrsinites* (Pursh) Raf., Fl. Tellur. 42. 1838; (1, 2, 5, 6, 8, 12, 13, 15, 16, 17, 20, 22, 25, 26, 30).

ACERACEAE. Maple Family

1. *Acer* L.

1. *Acer glabrum* Torrey, Ann. Lyc. N. Y. 2: 172. 1828; (1, 2, 3, 6, 8, 9, 10, 11, 12, 17, 20, 25, 26, 30, 31).
Acer Douglasii Hook., Lond. Jour. Bot. 6: 77. pl. 6. 1846; (5, 16, 22).
Acer glabrum Torrey var. *Douglasii* (Hook.) Piper, Mazama 2: 105. 1901; (13).

The differentiation of *A. Douglasii* from *A. glabrum* seems to be invalid as leaves typical of both may occur on the same tree.

RHAMNACEAE. Buckthorn Family

Fruit a drupe. Flowers solitary or in umbels. Flowers never blue. _____1. *Rhamnus.*
Fruit a dry capsule. Flowers in panicles. Flowers sometimes blue._____ 2. *Ceanothus.*

1. *Rhamnus* L.

1. *Rhamnus alnifolia* L'Her., Ser. Angl. 5. 1788; (1, 5, 8, 12, 13, 15, 20, 22, 31).

Crater Lake specimens have been determined as *R. californica* by western botanists. While our specimens have the same sepals as *R. californica,* the petals have wings less flaring and the leaves are wider and shorter, and are often minutely serrulate to entire.

2. *Ceanothus* L.

Leaves opposite. ----------1. *C. prostratus.*
Leaves alternate. ----------2. *C. velutinus.*

1. *Ceanothus prostratus* Benth., Pl. Hartw. 302. 1848; (1, 5, 10, 11, 12, 14, 18, 20, 25, 26, 30).

2. *Ceanothus velutinus* Dougl. in Hook., Fl. Bor. Am. 1: 125. 1830; (1, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 18, 20, 21, 22, 25, 26, 27, 28, 29, 30, 31).

MALVACEAE. Mallow Family

1. *Sidalcea* Gray

1. *Sidalcea spicata* (Regel) Greene, Bull. Cal. Acad. 1: 76. 1885; (1, 11, 12, 21, 25, 26).

HYPERICACEAE. St. Johnswort Family

1. *Hypericum* L.

Plants low, procumbent, 2 or 3 inches tall. ----------1. *H. anagalloides.*
Plants higher, erect, 6-18 inches tall. ----------2. *H. Scouleri.*

1. *Hypericum anagalloides* Cham. & Schlecht., Linnaea 3: 127. 1828; (1, 2, 5, 7, 10, 11, 12, 13, 14, 15, 16, 18, 20, 21, 24, 25, 28, 29).

2. *Hypericum Scouleri* Hook., Fl. Bor. Am. 1: 111. 1830; (1, 5, 6, 7, 13, 15, 16, 20, 22, 24, 26).

Hypericum formosum Gray var. *Scouleri* (Hook.) Coult., Bot. Gaz. 11: 108. 1886; (25, 29).

VIOLACEAE. Violet Family

1. *Viola* L.

Flowers blue or whitish.
  Peduncles not arising from the rootstocks. Flowers bluish. Some of the stems branching. ----------1. *V. adunca.*
  Peduncles arising directly from the rootstocks. Flowers whitish. None of the stems branching. ----------2. *V. blanda.*
Flowers yellow or yellowish.
  Flowers brownish purple on the outside.
    Leaves usually dentate, mostly broader than lanceolate. -----3. *V. purpurea.*
    Leaves usually entire or nearly so, purple-veined, mostly lanceolate. -- ----------4. *V. purpurea* var.
  Flowers bright yellow.
    Leaves cordate, not elongate. From a creeping rootstock.----5. *V. glabella.*
    Leaves mostly elongate. From a vertical rootstock. ---------6. *V. praemorsa.*

1. *Viola adunca* Smith, Rees' Cycl. 37: no. 63. 1817; (1, 2, 4, 5, 7, 8, 12, 15, 16, 17, 20, 21, 22, 24, 25, 26, 27, 29).

Viola canina L. var. *adunca* (Smith) Gray, Proc. Am. Acad. 8: 377. 1872; (10).

This plant has usually been referred to *V. canina* var. *adunca* Gray, but typically *V. canina* is a European form, and does not occur in our western states. This species is very variable in leaves and spur. A great many varieties and species have been founded on trivial variations. Ezra Brainerd has determined that the complete synonymy would include about 50 names. The form at Crater Lake is glabrous and might justly be referred to *V. adunca* var. *glabra* Brainerd.

2. *Viola blanda* Willd., Hort. Berol. Pl. 24. 1806; (1, 2, 8, 11, 12, 19, 24, 25, 28, 31).

3. *Viola purpurea* Kellogg, Proc. Calif. Acad. 1: 55. 1855; (1, 7, 10, 11, 21, 25, 26).

Viola aurea Kellogg, Proc. Calif. Acad. 2: 185. t. 54. 1862; (26).

4. *Viola purpurea* Kell. var. *venosa* (Wats.) Brainerd, Viol. N. Am., Vermont Agri. Exp. Sta. Bull. 224: 111. 1921; (25, 27).

Viola venosa (Wats.) Piper, Contri. U. S. Nat. Herb. 11: 393. 1906; (2, 5, 12, 13, 14, 20).

5. *Viola glabella* Nutt. in Torr. & Gray, Fl. N. Am. 1: 142. 1838; (1, 2, 4, 5, 6, 7, 10, 11, 12, 13, 15, 16, 20, 22, 25, 29).

6. *Viola praemorsa* Dougl., Bot. Reg., 15: pl. 1254. 1829; (1, 21, 25).

Viola Nuttallii Pursh var. *praemorsa* (Dougl.) Piper, Contri. U. S. Nat. Herb. 11: 393. 1906; (5, 15).

ONAGRACEAE. Evening Primrose Family

Parts of the flower in twos. ——— 1. *Circaea.*
Parts of the flower in fours.
  Seeds comose. Lower leaves mostly opposite. ——— 2. *Epilobium.*
  Seeds naked, not comose. Leaves all alternate.
    Anthers versatile. ——— 3. *Gayophytum.*
    Anthers not versatile. ——— 4. *Clarkia.*

1. *Circaea* L.

1. *Circaea alpina* L., Sp. Pl. 1: 9. 1753; (1, 2, 5, 6, 8, 12, 15, 16, 20, 21, 22, 31).

2. *Epilobium* L.*

Calyx-tube prolonged beyond the ovary. Flowers large. ——— 1. *E. angustifolium.*
Calyx-tube prolonged more or less beyond the ovary. Flowers small.
  Stigmas mostly 4-cleft. Annuals. Leaves narrow.
    Herbage crisp-puberulent. ——— 2. *E. minutum.*
    Herbage glabrous or glandular. ——— 3. *E. paniculatum.*
  Stigmas subentire. Perennials.
    Stems tall, 30-90 cm. high. ——— 4. *E. brevistylum.*
    Stems low. Mostly alpine and subalpine species.
      Seeds smooth (seen by a microscope.)
        Stems usually less than 1 dm. tall. ——— 6. *E. anagallidifolium.*
        Stems usually over 1 dm. tall.
          Flowers white or pinkish. ——— 7. *E. alpinum.*

* The key to the species as here presented is based on that of Piper, Contri. U. S. Nat. Herb. 11: 399. 1906.

Flowers purple or violet. ——— 8. *E. Hornemanni.*
Seeds papillate (seen by a microscope.)
Foliage glaucous. ——— 9. *E. fastigiatum.*
Foliage not glaucous.
Plants producing stolons.
Plants matted. Leaves firm, pale-green, sessile. ——— 10. *E. clavatum.*
Plants not matted. Leaves thin, bright-green, petiolate.
Flowers white or pinkish. ——— 7. *E. alpinum.*
Flowers purple or violet. ——— 8. *E. Hornemanni.*
Plants not producing stolons. ——— 5. *E. brevistylum* var.

1. *Epilobium angustifolium* L., Sp. Pl. 1: 347. 1753; (4, 5, 11, 12, 13, 15, 16, 22, 25, 28).

Epilobium spicatum Lam., Fl. Fr. 3: 482. 1778; (1, 7, 18).

Chamaenerion spicatum (Lam.) S.F. Gray, Nat. Arr. Brit. Pl. 2: 559, 1821; (31).

Chamaenerion angustifolium (L.) Schur, Sert. Fl. Transsilv., Verh. u. Mitth. des sieb. Vereins f. Naturwiss. z. Hermanstadt 4: p?. (p. 25 of reprint) 1853, as "*Chamenerium angustifolium* Scop"; (2).

2. *Epilobium minutum* Lindl. in Hook., Fl. Bor. Am. 1: 207. 1834; (1, 5, 10, 11, 13, 15, 16, 20, 25, 26).

3. *Epilobium paniculatum* Nutt. in Torr. & Gray, Fl. N. Am. 1: 490. 1840; (1, 2, 5, 7, 8, 9, 10, 12, 15, 16, 18, 19, 20, 24, 25, 26, 27, 31).

This is a variable species especially as to the extent of the branching. Its pubescence separates it from *E. minutum* which is the only species in the Park likely to be confused with it.

4. *Epilobium brevistylum* Barbey in Brewer & Wats., Bot. Calif. 1: 220. 1876; (1, 2, 5, 11, 16, 20, 21, 25).

5. *Epilobium brevistylum* Barbey var. *tenue* (Trel.) Jepson, Man. Fl. Pl. Calif. 670. 1925; (26).

Epilobium delicatum Trelease var. *tenue* Trelease, Rep. Mo. Bot. Gard. 2: 99. 1891; (5).

6. *Epilobium anagallidifolium* Lam., Encycl. 2: 376. 1786; (1, 2, 5, 6, 7, 8, 15, 16, 20, 21, 22, 24, 25).

This plant is of variant aspect. We refer only low, creeping forms to this species. Luxuriant forms will come to *E. alpinum* or to *E. Hornemanni* in the key.

7. *Epilobium alpinum* L., Sp. Pl. 1: 348. 1753; (1, 2, 5, 6, 8, 11, 15, 16, 17, 20, 21, 22, 25, 26, 31).

This plant has the size and general aspect of *E. Hornemanni* which it closely resembles except for its more delicate, pale leaves and smaller white or pinkish flowers. Some recent authors have united this species with *E. Hornemanni.*

8. *Epilobium Hornemanni* Reichenb., Ic. Fl. Germ. 2: 73. 1825; (1, 2, 4, 5, 6, 8, 13, 15, 20, 21, 22, 26, 31).

This variable species has been united with *E. alpinum* by some authors.

9. *Epilobium fastigiatum* (Nutt.) Piper, Contr. U. S. Nat. Herb. 11: 404. 1906; (5, 13, 16, 26).

Epilobium glaberrimum Barbey var. *latifolium* Barbey in Brewer & Wats., Bot. Calif. 1: 220. 1876; (1).

Epilobium glaberrimum Barbey var. *fastigiatum* (Nutt.) Trelease, Rep. Mo. Bot. Gard. 2: 105. 1891; (25).

10. *Epilobium clavatum* Trelease, Rep. Mo. Bot. Gard. 2: 111. 1891; (1, 5, 8, 15, 16, 20, 22, 26, 27).

Trelease (Rep. Mo. Bot. Gard. 2: 111. 1891) says of this species: "Suggestive of a hybrid between *E. anagallidifolium* and *E. Hornemanni*, but with much larger, abundant, and apparently good seeds."

3. *Gayophytum* Juss.

Capsules oblong, nearly sessile. Plants low, only a few inches tall.____ 1. *G. pumilum.*
Capsules on elongated pedicels. Plants tall, reaching 18 inches.____ 2. *G. diffusum.*

1. *Gayophytum pumilum* Wats., Proc. Am. Acad. 18: 193. 1883; (1, 2, 5, 10, 13, 20, 23, 26).

2. *Gayophytum diffusum* Torr. & Gray, Fl. N. Am. 1: 513. 1840; (1, 2, 5, 8, 10, 12, 20, 25, 26).

4. *Clarkia* Pursh

1. *Clarkia rhomboidea* Dougl. in Hook., Fl. Bor. Am. 1: 214. 1833; (1, 5, 10, 11, 12, 13, 14, 19, 24, 26, 27).

Phaeostoma rhomboidea (Dougl.) A. Nels., Bot. Gaz. 52: 267. 1911; (20).

UMBELLIFERAE. Parsley Family

Fruit bearing prickles, or bristles.
  Ribs of fruit none. Flowers yellowish. Fruit globose. ____ 1. *Sanicula.*
  Ribs of fruit present. Flowers white. Fruit linear. ____ 2. *Osmorhiza.*
Fruit not prickly nor bristly.
  Ribs of the fruit not winged. Fruit not flattened dorsally, sometimes flattened laterally.
    Fruit linear. ____ 2. *Osmorhiza.*
    Fruit ovate. ____ 5. *Ligusticum.*
  Ribs of the fruit, or some of them, winged.
    Lateral ribs winged, the dorsal and intermediate ribs filiform.
      Fruit flattened dorsally.
        Corollas of the marginal flowers of the umbel radiately enlarged. Oil-tubes reaching only half way to the base of the fruit. ____ 3. *Heracleum.*
        Corollas of the marginal flowers not radiately enlarged. Oil-tubes as long as the fruit.
          Stems reduced, the leaves and stems coming directly from the root-crown or from the short stem. ____ 4. *Cogswellia.*
          Stems tall, leafy. ____ 6. *Oxypolis.*
    Lateral, dorsal, and intermediate ribs all winged or very prominent.
      Umbellets capitate. Fruit cuneate-obovate, flattened dorsally, pubescent. ____ 7. *Sphenosciadium.*
      Umbellets not capitate. ____ 8. *Angelica.*

1. *Sanicula* L.

1. *Sanicula bipinnata* Hook. & Arn., Bot. Beechey Voy. 347. 1840; (1, 10, 19, 24, 25).

2. *Osmorhiza* Raf.

1. *Osmorhiza nuda* Torr., Pac. R. R. Rep. 4: 93. 1856; (1, 10, 11, 25).

Washingtonia nuda (Torr.) Heller, Cat. N. Am. Pl. 5. 1898; (24).

Osmorhiza nuda Torr. was originally described from specimens bearing immature fruit. Assuming that the fruit was obtuse at the apex Britton described (Ill. Fl. 2: 531. 1897.) our species as *Washingtonia divaricata.* Coulter and Rose, in their monograph on the North American Umbelliferae, followed Britton in assuming *O. nuda* to have blunt carpels. Jepson, in his Manual to the Flowering Plants of California, describes the species *nuda* as having a fruit with a constricted beak. If this is true (and Jepson probably had access to material from the type locality), then the species *divaricata* does not occur at Crater Lake. In the older books, our species may be found under the following names: *Osmorhiza divaricata* Nutt., *Washingtonia divaricata* Britton., *Washingtonia intermedia* Rydb.

3. *Heracleum* L.

1. *Heracleum lanatum* Michx., Fl. Bor. Am. 1: 166. 1803; (1, 2, 4, 5. 6, 8, 10, 11, 12, 13, 15, 16, 17, 21, 22, 23, 24, 26, 27, 28, 29, 31).

4. *Cogswellia* Spreng.

1. *Cogswellia Martindalei* (Coult. & Rose) Jones, Contri. Western Bot. 12: 34. 1908; (16).

Peucedanum Martindalei Coult. & Rose, Bot. Gaz. 13: 142. 1888; (1).

Lomatium Martindalei Coult. & Rose, Contr. U. S. Nat. Herb. 7: 225. 1902; (15).

5. *Ligusticum* L.

1. *Ligusticum apiifolium* (Nutt.) Gray, Proc. Am. Acad. 7: 347. 1868; (1, 4, 5, 6, 15, 16, 21).

Pimpinella apiodora Gray, Proc. Am. Acad. 7: 345. 1868; (10).

Ligusticum apiodorum (Gray) Coult. & Rose, Contri. U. S. Nat. Herb. 7: 132. 1902; (25).

The inclusion of *L. apiodorum* in the synonymy of our species is justified on the grounds that Gray's *L. apiodora* was based on material lacking mature fruit, and the vegetative characters are not sufficient to separate it from *L. apiifolium.* Coulter and Rose distinguish the two by means of the narrowness of the ultimate leaflet segments, but this character is variable.

6. *Oxypolis* Raf.

1. *Oxypolis occidentalis* Coult. & Rose, Contri. U. S. Nat. Herb. 7: 196. 1900; (12, 25).

7. *Sphenosciadium* Gray

1. *Sphenosciadium capitellatum* Gray, Proc. Am. Acad. 6: 537. 1865; (12, 19, 20, 25, 26).

Selinum capitellatum (Gray) Wats., Bot. King Explor. Exped. 126. 1871; (1).

8. *Angelica* L.

1. *Angelica genuflexa* Nutt. in Torr. & Gray, Fl. N. Am. 1: 620. 1840; (1, 5, 15, 16, 20).

ERICACEAE. Heath Family

Ovary 1-celled, style 1.
- Plants with chlorophyll.
  - Stems leafy. ---- 1. *Chimaphila.*
  - Stems scapose. ---- 2. *Pyrola.*
- Plants without chlorophyll.
  - Corolla absent. ---- 3. *Allotropa.*
  - Corolla present.
    - Petals united almost to their tips. ---- 4. *Pterospora.*
    - Petals distinct, or nearly so. ---- 5. *Monotropa.*

Ovary 3 to many-celled.
- Stamens raised to or near the summit of the ovary. ---- 6. *Vaccinium.*
- Stamens hypogynous.
  - Fruit a berry or drupe.
    - Bark reddish. Calyx small. Shrubs. ---- 7. *Arctostaphylos.*
    - Bark not reddish. Calyx becoming large and fleshy. Creeping. ---- 8. *Gaultheria.*
  - Fruit a dry capsule.
    - Leaves linear, heath-like. Corolla without pouches. ---- 9. *Phyllodoce.*
    - Leaves lanceolate. Corolla with 10 pouches which hold the anthers. ---- 10. *Kalmia.*

1. *Chimaphila* Pursh

Flowers more than three. Bracts of the inflorescence soon falling. 1. *C. umbellata* var.
Flowers three or fewer. Bracts of the inflorescence persistent through anthesis. ---- 2. *C. Menziesii.*

1. *Chimaphila umbellata* (L.) Bart. var. *occidentalis* (Rydb.) Blake, Rhodora 19: 242. 1917; (22).

Chimaphila umbellata (L.) Bart., Gen. Am. 1: 274. 1818, of western authors; (1, 2, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 21, 25, 27, 28).

Chimaphila occidentalis Rydb., N. Am. Fl. 29: 30. 1914; (20, 31).

2. *Chimaphila Menziesii* (R. Br.) Spreng., Syst. 2: 317. 1825; (1, 5, 7, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 24, 25).

2. *Pyrola* L.

Green leaves none or very rudimentary.
- Flowers red. ---- 1. *P. aphylla.*
- Flowers whitish. ---- 2. *P. picta.*

Green leaves plainly present.
- Style curved downwards.
  - Flowers whitish or greenish.
    - Veins of the leaves white bordered. ---- 2. *P. picta.*
    - Veins of the leaves not white bordered. ---- 3. *P. dentata.*
  - Flowers red or pink. ---- 4. *P. rotundifolia* var.
- Style straight.
  - Leaves ovate. Raceme 1-sided. ---- 5. *P. secunda.*
  - Leaves orbicular. Raceme not 1-sided. ---- 6. *P. minor.*

1. *Pyrola aphylla* Smith in Rees' Cycl. 29, n. 7. 1814; (1, 5, 7, 10, 11, 12, 13, 15, 16, 18, 19, 20, 24, 25, 27, 28).

2. *Pyrola picta* Smith, in Rees' Cycl., 29. n. 8. 1814; (1, 5, 8, 10, 11, 12, 13, 15, 16, 17, 18, 20, 21, 22, 24, 26, 28, 29, 31).

3. *Pyrola dentata* Smith in Rees' Cycl. 29. n. 6. 1814; (2, 5, 16, 18, 20, 24, 25).

This plant is variable in leaf characters. *P. dentata* var. *integra* Gray has been described as having entire and glaucous leaves. Many specimens from Crater Lake could be referred to the variety.

4. *Pyrola rotundifolia* L. var. *incarnata* DC., Prodr. 7: 773. 1839; (1).

Pyrola incarnata (DC.) Fisch. in DC., Prodr. 7: 773. 1839; (5, 12).

Pyrola elata Nutt., Trans. Am. Phil. Soc. N. Ser. 8: 270. 1843; (13, 16).

Pyrola uliginosa Torr. & Gray in Torr., Fl. N. Y. 1: 453. 1843; (20).

Pyrola asarifolia Michx. var. *incarnata* (DC.) Fernald, Rhodora 6: 178. 1904; (11, 21, 25).

5. *Pyrola secunda* L., Sp. Pl. 396. 1753; (1, 2, 4, 5, 6, 8, 10, 11, 12, 15, 16, 17, 22, 25).

Ramischia secunda (L.) Garcke, Fl. Deutschl. ed. IV. 222. 1858; (20).

6. *Pyrola minor* L., Sp. Pl. 396. 1753; (1, 2, 4, 5, 6, 8, 11, 12, 13, 15, 21, 22, 25, 26, 28).

Erxlebenia minor (L.) Rydb., N. Am. Fl. 29: 28. 1914; (20).

3. *Allotropa* Torr. & Gray

1. *Allotropa virgata* Torr. & Gray, Proc. Am. Acad. 7: 368. 1868; (10, 12, 14, 15, 16, 21, 25).

4. *Pterospora* Nutt.

1. *Pterospora Andromedea* Nutt., Gen. Am. 1: 269. 1818; (1, 2, 5, 7, 8, 10, 11, 12, 14, 15, 18, 20, 22, 25, 26, 31).

5. *Monotropa*

1. *Monotropa hypopitys* L., Sp. Pl. 1: 387. 1753.

Hypopitys lanuginosa (Michx.) Nutt., Gen. N. Am. Pl. 1: 271. 1818; (31).

Hypopitys hypopitys (L.) Small, Mem. Torr. Bot. Club 4: 137. 1892; (2, 5, 7, 12, 14, 15, 16).

6. *Vaccinium* L.

Shrubs robust, 2 feet or more high. ---------- 1. *V. membranaceum.*

Shrubs low, about 1 foot or less high.

Branches not angled.

Flowers in clusters of 2 or 4. Calyx-tube deeply 4-5 parted. ---------- 2. *V. occidentale.*

Flowers solitary. Calyx-tube obscurely lobed. ---------- 3. *V. caespitosum.*

Branches angled.

Berries black. Branches loosely spreading. ---------- 4. *V. Myrtillus.*

Berries red. Branches thick, broom-like. ---------- 5. *V. scoparium.*

1. *Vaccinium membranaceum* Dougl. in Hook., Fl. Bor. Am. 2: 32. 1834; (1, 2, 4, 8, 12, 15, 20, 22, 25, 26, 30, 31).

Vaccinium macrophyllum (Hook.) Piper, Contrib. U. S. Nat Herb. 11: 443. 1906; (5, 13, 16).

2. *Vaccinium occidentale* Gray, in Brewer & Wats., Bot. Calif. 1: 451. 1876; (1, 2, 5, 8, 10, 11, 12, 16, 20, 21, 25, 26, 28, 30).

This species may easily be confused with *V. uliginosum*, but that species

has rounder leaves conspicuously reticulated beneath, shorter and broader corolla, and larger berries.

3. *Vaccinium caespitosum* Michx., Fl. Bor. Am. 1: 234. 1803; (1, 2, 4, 5, 6, 8, 10, 12, 13, 15, 16, 20, 21, 22, 25, 28, 29, 30, 31).

Vaccinium caespitosum Michx. var. *cuneifolium* Nutt. in Gray, Trans. Phil. Soc. Phila. N. Ser. 8: 263. 1843; (11).

4. *Vaccinium Myrtillus* L., Sp. Pl. 349. 1753; (1, 2, 4, 22, 25).

The only specimens that we have seen have been European. Coville (Mazama, Vol. 1, The Aug. Veg. of Mt. Mazama) reports its presence in the Park rather indefinitely as follows: "A small black-fruited species with angular stems. This Mr. Leiberg thinks he saw near the head of Anna Creek."

5. *Vaccinium scoparium* Leiberg, Mazama 1: 196: 1897; (5, 8, 12, 13, 15, 16, 17, 20, 22, 26, 30, 31).

Vaccinium Myrtillus L. var. *microphyllum* Hook., Fl. Bor. Am. 2: 33. 1834. (11, 25).

7. *Arctostaphylos* Adans.

Dwarf or procumbent shrubs. ---------- 1. *A. nevadensis.*
Erect robust shrubs. ---------- 2. *A. patula.*

1. *Arctostaphylos nevadensis* Gray, Syn. Fl. 2: 27. 1878; (1, 5, 10, 11, 12, 16, 21, 25, 26, 30).

2. *Arctostaphylos patula* Greene, Pitt. 2: 171. 1891; (11, 25, 30).

Uva-ursi patula (Greene) Abrams, Bull. N. Y. Bot. Gard. 6: 434. 1910; (19).

8. *Gaultheria* L.

1. *Gaultheria humifusa* (Graham) Rydb., Mem. N. Y. Bot. Gard. 1: 300. 1900; (2, 5, 6, 8, 12, 16, 20, 22, 25, 26, 30).

Gaultheria Myrsinites Hook., Fl. Bor. Am. 2: 35. t. 129. 1834; (1, 15).

9. *Phyllodoce* Salisb.

Corolla yellowish, glandular. ---------- 1. *P. glanduliflora.*
Corolla reddish, not glandular. ---------- 2. *P. empetriformis.*

1. *Phyllodoce glanduliflora* (Hook.) Rydb., Mem. N. Y. Bot. Gard. 1: 299. 1900; (1, 2, 5, 6, 7, 8, 12, 14, 15, 16, 20, 22, 28, 30).

Bryanthus glanduliflorus (Hook.) Gray, Proc. Am. Acad. 7: 368. 1868; (4).

2. *Phyllodoce empetriformis* (Smith) D. Don, Edinb. New Phil. Jour. 17: 160. 1834; (2, 5, 6, 7, 8, 12, 13, 14, 15, 16, 20, 22, 25, 26, 28, 30).

Bryanthus empetriformis (Smith) Gray, Proc. Am. Acad. 7: 367. 1868; (1, 4, 10).

10. *Kalmia* L.

1. *Kalmia polifolia* Wangenh. var. *microphylla* (Hook.) Rehder in Bailey, Cycl. Hort. 2: 854. 1900; (15, 16, 21, 25).

Kalmia glauca Ait. var. *microphylla* Hook., Fl. Bor. Am. 2: 41. 1834; (1, 5).

Kalmia microphylla (Hook.) Heller, Bull. Torr. Bot. Club 25: 581. 1898; (2, 6, 20, 22, 26, 30).

PRIMULACEAE. Primrose Family

Stems short. Leaves in a basal rosette. ---------- 1. *Dodecatheon.*
Stems elongated, leaf-bearing. ---------- 2. *Trientalis.*

1. *Dodecatheon* L.

1. *Dodecatheon alpinum* (Gray) Greene, Erythea 3: 39. 1895; (1, 7, 11, 12, 20, 21, 24, 25, 26).

D. alpinum and *D. tetrandrum* have both been reported from the Park, but we cannot find the difference between these species that Greene (Erythea 3: 39 and 40. 1895) found. He says that *D. alpinum* has a distinct horizontal or ascending rootstock which is bulbilliferous at least when mature; the capsule is valvate from the very apex, while *D. tetrandrum* grows from a short vertical rootstock which is not bulbilliferous; and the capsules are circumscissile very near the apex.

2. *Trientalis* L.

1. *Trientalis europaea* L., Sp. Pl. 344. 1753; (10, 11, 18, 25, 29).

Trientalis latifolia Hook., Fl. Bor. Am. 2: 121. 1838; (2, 5, 7, 12, 13, 14, 15, 16, 20).

We have matched our specimens with European material and can find no difference. Our material is supposed to have broader leaves than European specimens.

GENTIANACEAE. Gentian Family

1. *Gentiana* L.

1. *Gentiana simplex* Gray, Pac. R. R. Rep. 5: 87. t. 16. 1857; (1, 11, 21, 24, 25).

APOCYNACEAE. Dogbane Family

1. *Apocynum* L.

1. *Apocynum pumilum* (Gray) Greene, Man. Bot. San Francisco Bay Reg. 240. 1894; (13, 20, 22).

Apocynum androsaemifolium L. var. *pumilum* Gray, Syn. Fl. 2: 83. 1878; (1, 5, 10, 11, 15, 21, 25).

POLEMONIACEAE. Phlox Family

Calyx distended and at length burst by the capsule. Leaves opposite or alternate.
  Leaves opposite, entire. Plant perennial. Corolla salverform. ----------1. *Phlox.*
  Not as above in the first 3 points. Corolla often not salverform. --------2. *Gilia.*
Calyx not distended nor burst by the capsule. Leaves alternate.
  Calyx-teeth spine-tipped. Leaves compound. Stamens inserted at unequal heights in the corolla-tube. ----------3. *Navarretia.*
  Calyx-teeth herbaceous, not spine-tipped.
    Leaves compound, pinnate. Leaflets entire (in ours). Stamens inserted equally high in the corolla tube. Corolla rotate to funnelform. ----------4. *Polemonium.*
    Leaves simple, entire or pinnately or palmately dissected. Stamens inserted at unequal heights in the corolla tube. Corolla salverform to funnelform. ----------5. *Collomia.*

1. *Phlox* L.

1. *Phlox Douglasii* Hook., Fl. Bor. Am. 2: 73. 1838; (1, 2, 5, 7, 11, 14, 15, 18, 20, 24, 25, 26, 28).

2. *Gilia* Ruiz & Pav.

Plants perennial or biennial.
Flowers in an elongate panicle. Corolla large, tubular-funnelform, usually scarlet. ---------- 1. *G. aggregata.*
Flowers in corymbs or heads, rather small, white or whitish.--- 2. *G. congesta* var.
Plants annual. Lower leaves opposite, the upper ones alternate. ------ 3. *G. gracilis.*

1. *Gilia aggregata* (Pursh) Spreng., Syst. 1: 626. 1825; (1, 2, 5, 8, 11, 13, 14, 15, 18, 20, 21, 25, 26, 27, 28, 31).

2. *Gilia congesta* Hook. var. *palmifrons* (Rydb.) Brand. in Engler, Pflazr. 4: 122. 1907; (21).

Gilia montana Nels. & Kenn., Proc. Biol. Soc. Wash. 19: 37. 1906; (20, 26).

3. *Gilia gracilis* (Dougl.) Hook., Bot. Mag. 56: pl. 2924. 1829; (1, 5, 7, 10, 11, 13, 15, 16, 27).

Collomia gracilis Dougl., in Benth., Bot. Reg. N. Ser. 6: 1622. 1833; (2).
Phlox gracilis (Dougl.) Greene, Pittonia 1: 141. 1887; (25).
Microsteris gracilis (Dougl.) Greene, Pittonia 3: 300. 1898; (20, 26).

3. *Navarretia* R. & P. Prodr.

1. *Navarretia divaricata* (Torr.) Greene, Pittonia 1: 136. 1887; (1, 5, 11, 12, 25).

4. *Polemonium* L.

Plants tall, normally 2 or 3 feet high. ---------- 1. *P. occidentale.*
Plants low, at most a foot or less high.
Leaflets about 1 inch long. ---------- 2. *P. humile.*
Leaflets about ¼ inch long. ---------- 3. *P. viscosum* var.

1. *Polemonium occidentale* Greene, Pitt. 2: 75. 1890; (1, 2, 7, 8, 11, 12, 14, 20, 21, 25, 26, 27, 31).

Polemonium caeruleum L., Sp. Pl. 162. 1753, at least of some western authors; (5, 14, 15, 18).

2. *Polemonium humile* Roem. & Schult., Syst. 4: 792. 1819; (1, 5, 10, 13, 15, 16).

Polemonium pulchellum Bunge in Ledeb., Fl. Alt. 1: 233. 1829; (1, 2, 27).
Polemonium pulcherrimum Hook., Bot. Mag. N. Ser. 4: t. 2979. 1830; (11, 20, 21, 25, 26).

3. *Polemonium viscosum* Nutt. var. *elegans* (Greene) Brand in Engler, Pflzr. 4: 44. 1907; (1, 5, 12, 16).

5. *Collomia* Nutt.

Inflorescence not dense nor head-like. Corolla small, 2-4 mm. wide. ---- 1. *C. tinctoria.*
Inflorescence dense and head-like. Corolla larger, more than 4 mm. wide.
Flowers deep blue. ---------- 2. *C. mazama.*
Flowers salmon-yellow. ---------- 3. *C. grandiflora.*

1. *Collomia tinctoria* Kell., Proc. Cal. Acad. 3: 17. t. 2. 1863; (1, 25, 26).

2. *Collomia mazama* Coville, Proc. Biol. Soc. Wash. 11: 35. pl. 1. 1897; (1, 12).

3. *Collomia grandiflora* Dougl. in Lindl., Bot. Reg. 14: pl. 1174. 1828; (1, 2, 5, 7, 10, 12, 13, 14, 16, 20, 24, 25, 26, 29).

Gilia grandiflora (Dougl.) Gray, Proc. Am. Acad. 17: 223. 1882; (11, 18, 27, 28).

HYDROPHYLLACEAE. Water-leaf Family

1. *Phacelia* Juss.

Plants not low, at least over 6 inches high. ——1. *P. heterophylla.*
Plants low, usually 2-4 inches high. ——2. *P. heterophylla* var.

1. *Phacelia heterophylla* Pursh, Fl. Am. Sept. 1: 140. 1814; (1, 2, 5, 6, 8, 13, 15, 20, 25, 26, 27, 29).

2. *Phacelia heterophylla* Pursh var. *pygmaea* Jepson, Man. Fl. Pl. Calif. 819. 1925; (25).

BORAGINACEAE. Borage Family

Nutlets armed with barbed prickles. ——1. *Lappula.*
Nutlets not armed with barbed prickles.
Corolla tubular or tubular-funnelform, blue. ——2. *Mertensia.*
Corolla funnelform or rotate.
Perennials, or if annuals, having the gynobase elongate and the nutlets attached by 1/3 their length or more. ——3. *Cryptantha.*
Annuals, gynobase low. ——4. *Plagiobothrys.*

1. *Lappula* Moench

Flowers blue. ——1. *L. diffusa.*
Flowers white. ——2. *L. californica.*

1. *Lappula diffusa* (Lehm) Greene, Pitt. 2: 182. 1891; (1, 2, 5, 6, 13, 15, 20, 22, 26).

2. *Lappula californica* (Gray) Piper, Bull. Torr. Club 29: 546. 1902; (11, 14, 18, 21, 25).

2. *Mertensia* Roth

1. **Mertensia paniculata** (Ait.) G. Don, var. **laevigata** (Piper) L. Williams, comb. nov.

Mertensia sibirica Don, Syst. IV. 320. 1838, of western authors; (1, 2, 7, 11, 18, 28).

Mertensia laevigata Piper, Contr. U. S. Nat. Herb. 11: 477. 1906.

Mertensia paniculata (Ait.) D. Don, var. *subcordata*, of western authors.

3. *Cryptantha* Lehm.

Perennials. ——1. *C. caespitosa.*
Annuals. Gynobase elongate, the nutlets attached by 1/3 their length or more. ——2. *C. affinis.*

1. *Cryptantha caespitosa* (Nels.) Payson, Ann. Mo. Bot. Gard. 14: 281. 1927.

Oreocarya caespitosa Nels., Erythea 7: 65. 1899; (20).

2. *Cryptantha affinis* (Gray) Greene, Pittonia 1: 119. 1887; (1, 2, 5, 11, 13, 15, 20, 21, 22, 25, 26).

4. *Plagiobothrys* F. & M.

1. *Plagiobothrys leptocladus* (Greene) Johnston, Contrib. Arnold Arb. 3: 38. 1932.

Allocarya humistrata Greene, Pittonia 1: 16. 1887, in part; (25).

Allocarya subglochidiata (Gray) Piper, Contri. U. S. Nat. Herb. 11: 485. 1906; (5).

LABIATAE. Mint Family

1. *Stachys* L.

1. *Stachys bullata* Benth., Lab. Gen. et Sp. 547. 1834; (1, 5, 10, 12, 14, 16, 18, 24, 25, 28, 29).

SOLANACEAE. Nightshade Family

1. *Chamaesaracha* Gray

1. *Chamaesaracha nana* Gray, Proc. Am. Acad. 10: 62. 1874; (25, 26).

SCROPHULARIACEAE. Figwort Family

Fifth sterile stamen present.
- Sterile stamen elongated, filament-like. ---- 1. *Penstemon.*
- Sterile stamen represented by a gland or scale on the upper side of the corolla-tube.
  - Peduncles several-flowered. ---- 2. *Scrophularia.*
  - Peduncles 1-flowered. ---- 3. *Collinsia.*

Fifth sterile stamen wanting, all anther bearing.
- Stamens 2. Calyx 4-parted. ---- 4. *Veronica.*
- Stamens 4. Corolla distinctly 2-lipped.
  - Stamens not enclosed in the upper lip. Leaves opposite. Calyx prismatic. ---- 5. *Mimulus.*
  - Stamens enclosed in the upper lip of the corolla.
    - Anther-cells equal, parallel. Leaves alternate or whorled. 6. *Pedicularis.*
    - Anther-cells unequal.
      - Lips of the corolla very unequal, the upper larger. ---- 7. *Castilleja.*
      - Lips of the corolla subequal, the upper slightly if at all larger than the lower. ---- 8. *Orthocarpus.*

1. *Penstemon.* Soland.

Anthers woolly.
- Foliage glaucous. ---- 1. *P. rupicola.*
- Foliage not glaucous, green. ---- 2. *P. Menziesii* var.

Anthers not woolly.
- Plants glabrous, more or less glaucous. ---- 3. *P. glaber.*
- Plants not glabrous.
  - Corolla yellowish. ---- 4. *P. confertus.*
  - Corolla blue. ---- 5. *P. micranthus.*

1. *Penstemon rupicola* Howell, Fl. N. W. Am. 510. 1901; (1, 5, 16).

Intermediate forms connect this species with *P. Newberryi.*

2. *Penstemon Menziesii* Hook. var. *Davidsonii* (Greene) Piper, Contrib. U. S. Nat. Herb. 11: 499. 1906; (5, 11, 16, 21, 25).

Penstemon Davidsonii Greene, Pitt. 2: 241. 1892; (1, 26).

3. *Penstemon glaber* Pursh, Fl. Am. Sept. 738. 1814; (1, 5, 13, 20, 21, 25, 31).

Our plant is not typical, and does not fall exactly into any of the described varieties of Jepson (Man. Fl. Pl. Calif. 913. 1925).

4. *Penstemon confertus* Dougl. in Lindl., Bot. Reg. 15: pl. 1260. 1829; (1, 2, 4, 5, 6, 8, 10, 12, 14, 15, 16, 20, 22, 25, 28).

5. *Penstemon micranthus* Nutt., Jour. Acad. Nat. Sci. Phila. 7: 45. 1834.

Penstemon confertus Dougl. var. *caeruleo-purpureus* Gray, Proc. Am. Acad., 6: 72. 1862-63, in part; (4, 14, 25).

Penstemon procerus Dougl. in Graham, Edin. New Phil. Jour. 7: 348. 1892, of western authors; (1, 2, 6, 13, 15, 16, 20, 21, 22, 26, 31).

Penstemon pulchellus Greene, Pitt. 3: 310. 1898; (1).

See Pennell, "Scrophulariaceae of eastern temperate North America," Acad. Nat. Sci. Phila., Mono. 1: 202, 632. 1935, for a discussion of the status of this species.

2. *Scrophularia* L.

1. *Scrophularia californica* Cham. & Schlecht., Linnaea 2: 585. 1827; (1, 5, 10, 11, 12, 13, 14, 15, 16, 18, 19, 25, 26, 27).

3. *Collinsia* Nutt.

1. *Collinsia parviflora* Dougl. in Lindl., Bot. Reg. 13: pl. 1082. 1827; (1, 2, 4, 6, 7, 10, 12, 15, 20, 21, 22, 24, 25, 27, 29, 31).

Tonella tenella (Pursh) Jepson, Fl. W. Mid. Calif. 400. 1901; (10, 25).

Collinsia tenella (Pursh) Piper, Contri. U. S. Nat. Herb. 11: 496. 1906; (5, 8, 13, 16, 17, 26).

4. *Veronica* L.

Peduncles terminal.
Capsules elliptic, emarginate. Leaves all sessile. ----------1. *V. Wormskioldii.*
Capsules orbicular, obcordate. Lower leaves petioled. ------2. *V. serpyllifolia.*
Peduncles axillary. ----------3. *V. americana.*

1. *Veronica Wormskioldii* Roem. & Schult., Syst. 1: 101. 1817; (1, 2, 6, 14, 17, 20, 31).

Veronica alpina L., Sp. Pl. 11. 1753; (4, 5, 8, 11, 15, 16, 18, 24, 25).

2. *Veronica serpyllifolia* L., Sp. Pl. 12. 1753; (1, 2, 4, 5, 6, 7, 8, 11, 12, 15, 17, 20, 22, 24, 25, 26, 29).

3. *Veronica americana* Schwein. in DC., Prodr. 10: 68. 1846; (1, 2, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 20, 22, 24, 25, 26, 27, 28, 29, 31).

5. *Mimulus* L.

Flowers reddish or purple.
Stigmas funnel-form. Corolla 1½-2 cm. long. ----------1. *M. nanus.*
Stigmas 2-lipped. Corolla very small to very large.
Flowers very small, less than 1 cm. long, pale purple. --------2. *M. Breweri.*
Flowers large, over 2 cm. long. Corolla rose-purple. --------3. *M. Lewisii.*
Flowers yellow.
Flowers solitary on scapes. ----------4. *M. primuloides.*
Flowering stems leafy, not scape-like.
Leaves pinnately veined. Herbage slimy- viscid. ----------5. *M. moschatus.*
Leaves palmately veined. Herbage not viscid.
Flowers ¾-1¾ inches long. Plants normally 1-2 feet high. 6. *M. guttatus.*
Flowers ¼-¾ inches long. Plants 2-12 inches high. --7. *M. guttatus* var.

1. *Mimulus nanus* Hook. & Arn., Bot. Beechey's Vogage 378. 1840; (5, 8, 11, 12, 13, 21, 25, 26).

Eunanas Tolmei Benth. in DC., Prodr. 10: 374. 1846; (1).

2. *Mimulus Breweri* (Greene) Cov., Contri. U. S. Nat. Herb. 4: 171. 1893; (2, 5, 11, 12, 13, 16, 20, 21, 26).

Mimulus rubellus Gray, Bot. Calif. 1: 568. 1876, in part; (1, 8, 17, 24).

Eunanus Breweri Greene, Bull. Calif. Acad. Sci. 1: 101. 1885; (1).

Mimulus rubellus Gray var. *Breweri* (Greene) Jepson, Man. Fl. Pl. Calif. 927. 1925; (25).

Grant states (Ann. Mo. Bot. Gard. 11: 264. 1924):

This species has been generally confused with *M. rubellus* to which it is closely related. It differs from that species, principally in being glandular-pubescent or glandular-puberulent, in the shape of the calyx-teeth, and in the placentae being firmly adherent for most of their length. The pedicels are usually longer than the calyx, but all gradations occur from those with pedicels much shorter than the calyx to those nearly twice as long.

3. *Mimulus Lewisii* Pursh, Fl. Am. Sept. 2: 427. pl. 20. 1814; (1, 2, 4, 5, 6, 8, 11, 12, 13, 14, 15, 16, 18, 20, 21, 22, 25, 26, 28, 31).

4. *Mimulus primuloides* Benth., Scroph. Ind. 29. 1835; (1, 5, 11, 12, 14, 20, 21, 25, 28).

Mimulus pilosellus Greene, Erythea 4: 22. 1896; (1).

Mimulus primuloides Benth. var. *pilosellus* (Greene) Smiley, Univ. Calif. Publ. Bot. 9: 332. 1921; (21).

One often sees a tall form about four inches high and a much shorter one which may be but an inch or two high growing together around the same mossy spring. Greene described the low form (see synonymy above) as *M. pilosellus*. He explains the series of gradations between the small and the larger specimens as the result of hybridization. This seems very improbable, and since they are exactly alike except for height, we have followed Grant (Ann. Mo. Bot. Gard. 11: 243. 1924) in referring both forms to the same species.

5. *Mimulus moschatus* Dougl. in Lindl., Bot. Reg. pl. 1118. 1828; (1, 2, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 22, 24, 25, 26, 28, 29, 31).

6. *Mimulus guttatus* DC., Cat. Monsp. 127. 1813; (25, 26, 27, 31).

Mimulus Langsdorfi J. Donn, Sim's Bot. Mag. pl. 1501. 1812; (1, 2, 4, 5, 7, 8, 12, 13, 14, 15, 16, 17, 19, 20, 21, 24, 29).

Mimulus luteus J. Donn, Sim's Bot. Mag. pl. 1501. 1812; (11, 18, 28).

Mimulus Langsdorfi J. Donn var. *guttatus* Jepson, Fl. W. Mid. Calif. 406. 1901; (10).

Mimulus grandiflorus Howell, Fl. N. W. Am. 520. 1901; (1).

7. *Mimulus guttatus* DC. var. *depauperatus* (Gray) Grant, Ann. Mo. Bot. Gard. 11: 170. 1924; (25).

Mimulus microphyllus Benth. in DC., Prodr. 10: 371. 1846; (1, 5, 12, 19, 26).

Mimulus Langsdorfi J. Donn var. *depauperatus* Gray according to Henry, Fl. Brit. Columbia 268. 1915; (15).

6. *Pedicularis* L.

Leaves pinnately parted. ----------1. *P. groenlandica.*

Leaves lanceolate, serrate or crenate, but not pinnately parted. -------2. *P. racemosa.*

1. *Pedicularis groenlandica* Retz., Prod. Fl. Scand. Ed. 2. 145. 1795; (1, 2, 4, 5, 8, 11, 12, 14, 15, 18, 21, 22, 26, 28).

Elephantella groenlandica (Retz.) Rydb., Mem. N. Y. Bot. Gard. 1: 362. 1900; (6).

2. *Pedicularis racemosa* Dougl. in Hook., Fl. Bor. Am. 2: 108. 1838; (1, 2, 4, 5, 6, 7, 8, 12, 13, 15, 16, 17, 21, 22, 26).

Heller distributed Crater Lake material as a new species although his name was never published. F. W. Pennell thinks that the Crater Lake specimens are merely highly colored forms. The flowers of typical specimens are usually pale pink.

7. *Castilleja* Mutis

The lower lip of the corolla greenish, about 2 mm. long, deeply cleft into 3 subequal linear attenuate incurved lobes. ----------2. *C. Applegatei.*

The lower lip of the corolla not as above in all points.

Plants with a slender running rootstock, usually inhabiting damp places. ---------- 4. *C. Suksdorfii.*

Plants without a slender running rootstock, usually inhabiting dry places.

Herbage glabrous, at least below. ----------1. *C. miniata.*

Herbage glandular-pubescent in varying degrees. ----------3. *C. pinetorum.*

1. *Castilleja miniata* Dougl. in Hook., Fl. Bor. Am. 2: 106. 1838; (1, 2, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 20, 21, 25, 26, 28).

2. *Castilleja Applegatei* Fernald, Erythea 6: 49. 1898; (1, 12).

3. *Castilleja pinetorum* Fernald, Erythea 6: 50. 1898; (1, 12, 14, 21, 25, 26).

4. *Castilleja Suksdorfii* Gray, Proc. Am. Acad. 22: 311. 1887; (1, 2, 5, 12, 15, 16, 20).

Suksdorf has called attention (Proc. Am. Acad. 22: 312. 1886) to the differences between this plant and forms of *miniata* which it closely resembles. *C. miniata* grows in clumps of many stems from a stout stock or perennial root, and is wholly destitute of the filiform subterranean creeping shoots by which its related species loosely spreads and multiplies. Also *C. miniata* commonly bears one or two flowering branches near the summit of the stems, and the red of the bracteal leaves is diffused instead of ending abruptly.

8. *Orthocarpus* Nutt.

Inflorescence-bracts yellow or yellowish. Stems white-woolly pubescent.---1. *O. pilosus.*

Inflorescence-bracts pink or reddish. Stems not white-woolly pubescent but may be somewhat pilose. ----------2. *O. imbricatus.*

1. *Orthocarpus pilosus* Wats., Bot. King Explor. Exped. 231. 1871; (5, 11, 12, 25).

Castilleja pilosa (Wats.) Rydb., Mem. N. Y. Bot. Gard. 1: 361. 1900; (1, 2).

This species seems to be one of the connecting links between *Castilleja* and *Orthocarpus*. Its perennial character and very slightly saccate lower lip indicate its relation to *Castilleja*, while its short galea is typical of *Orthocarpus*.

2. *Orthocarpus imbricatus* Torr. in Wats., Bot. King Explor. Exped. 458. 1871; (1, 5, 11, 12, 16).

OROBANCHACEAE. Broomrape Family

1. *Orobanche* L.

Calyx-lobes subulate, longer than the tube. ----------1. *O. uniflora* var.
Calyx-lobes triangular, shorter than the tube. ----------2. *O. fasciculata.*

1. *Orobanche uniflora* L. var. *Sedi* (Suksdorf) Achey, Bull. Torr. Bot. Club 60: 446. 1933.

Orobanche uniflora L., Sp. Pl. 2: 633. 1753; (10, 11, 15, 25, 27, 29).

Thalesia uniflora (L.) Britton, Mem. Torr. Club 5: 298. 1894, of western authors; (1, 5, 7, 8, 12, 13, 14, 16, 26).

2. *Orobanche fasciculata* Nutt., Gen. Am. 2: 59. 1818; (10, 11, 15, 25, 27).

Thalesia fasciculata (Nutt.) Britton, Mem. Torr. Club 5: 298. 1894; (1, 2, 5, 7, 8, 12, 13, 16, 17, 19, 20, 24, 27).

Aphyllon fasciculatum (Nutt.) Torr. & Gray, Syn. Fl. 2: 312. 1878; (18).

We have seen but a single plant within the Park. It was growing in the dry pumice on the very edge of the Rim, at Sentinel Point. More copious material is necessary for the varietal distinctions described by Achey (Bull. Torr. Bot. Club 60: 447. 1933).

RUBIACEAE. Madder Family

Leaves whorled, without stipules. ----------1. *Galium.*
Leaves opposite, with stipules. ----------2. *Kelloggia.*

1. *Galium* L.

Annuals. Fruit hispid or hirsute.
Stems reclining. Fruit 4-6 mm. broad. ----------1. *G. aparine.*
Stems erect or ascending. Fruit 2-3 mm. broad. ----------2. *G. aparine* var.
Perennials. Fruit smooth, hispid or canescent.
Whorls containing 6 leaves. Fruit hispid with hooked hairs.------ 3. *G. triflorum.*
Whorls containing 4, 5, or 6 leaves. Fruit smooth. ----------4. *G. trifidum.*

1. *Galium aparine* L., Sp. Pl. 1: 108. 1753; (1, 2, 5, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 24, 25, 26, 27, 31).

2. *Galium aparine* L. var. *Vaillantii* (DC.) Koch, Syn. Fl. Germ. et Helvet. 283. 1857.

Galium Vaillantii DC. in DC. & Lam., Fl. France 4: 263. 1805; (2, 5, 8, 12, 13, 20, 26, 31).

3. *Galium triflorum* Michx., Fl. N. Am. 1: 80. 1803; (1, 2, 4, 5, 7, 8, 10, 11, 12, 13, 15, 16, 17, 20, 22, 24, 25, 26, 27, 29, 31).

4. *Galium trifidum* L., Sp. Pl. 105. 1753; (1, 2, 5, 7, 8, 10, 11, 12, 13, 16, 19, 20, 22, 24, 25, 31).

This is a very variable species. Some botanists recognize our form as being the variety *pusillum* of Gray.

2. *Kelloggia* Torr.

1. *Kelloggia galioides* Torr., Bot. Wilkes Exped. 332. 1874; (1, 5, 8, 10, 11, 12, 13, 14, 20, 24, 26).

CAPRIFOLIACEAE. Honeysuckle Family

Corolla rotate to deeply saucer-shaped. Flowers in compound cymes. ..1. *Sambucus.*
Corolla tubular or bell-shaped. Flowers not in compound cymes.
Corolla regular, bell-shaped. ..2. *Symphoricarpos.*
Corolla more or less irregular, tubular, commonly 2-lipped. ..3. *Lonicera.*

1. *Sambucus* L.

Berries red when ripe. ..1. *S. racemosa.*
Berries dark purple to blackish when ripe. ..2. *S. melanocarpa.*

1. *Sambucus racemosa* L., Sp. Pl. 270. 1753; (4, 9, 10, 11, 15, 21, 25).
Sambucus leiosperma Leiberg, Proc. Biol. Soc. Wash. 11: 40. 1897; (1).
Sambucus callicarpa Greene, Fl. Francisc. 342. 1891, of western authors.

The names *S. callicarpa* and *S. racemosa* have been indiscriminately applied to the low bush and the larger tree-like form. Jepson (Man. Fl. Pl. Calif. 965. 1925) reserves the name *racemosa* for the low bush form and refers the tree-like forms to *S. racemosa* var. *callicarpa* Jepson. Leiberg (Proc. Biol. Soc. Wash. 11: 40. 1897) described our species as *S. leiosperma,* but it is included in *S. racemosa.*

2. *Sambucus melanocarpa* Gray, Proc. Am. Acad. 19: 76. 1883; (1, 2, 4, 5, 6, 8, 12, 15, 17, 20, 21, 22, 26, 27).

2. *Symphoricarpos* Juss.

1. *Symphoricarpos mollis* Nutt. in Torr. & Gray, Fl. N. Am. 2: 4. 1841; (5, 10, 11, 12, 13, 16, 19, 24, 25, 26, 29, 30).

The leaves of the sterile shoots are very variable in size, shape, toothing and lobation.

3. *Lonicera* L.

Bracts large, foliaceous. Flowers yellow. ..1. *L. involucrata.*
Bracts small and narrow to very inconspicuous. Flowers black-purple. 2. *L. conjugialis.*

1. *Lonicera involucrata* (Richards.) Spreng., Syst. Veg. 1: 759. 1825; (2, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 18, 22, 25, 26, 27, 28, 29, 30).
Xylosteum involucratum Richards., Bot. App. Frankl. Jour. 733. 1823; (1).
Distegia involucrata (Richards.) Rydhb., Bull. Torr. Bot. Club 33: 152. 1906; (17, 20).

2. *Lonicera conjugialis* (Howell) Kellogg, Proc. Am. Acad. 2: 67. 1863; (5, 10, 11, 12, 18, 21, 25, 26, 30).
Xylosteum conjugialis Howell, Fl. N. W. Am. 282. 1902; (1).

VALERIANACEAE. Valerian Family

1. *Valeriana* L.

1. *Valeriana sitchensis* Bong., Mem. Acad. St. Petersb. VI. 2: 145. 1832; (1, 4, 5, 6, 7, 12, 13, 15, 16, 20, 22).

CAMPANULACEAE. Bellflower Family

1. *Campanula* L.

1. *Campanula Scouleri* Hook. in A. DC., Monog. Comp. 312. 1830; (1, 5, 7, 10, 12, 14, 15, 16, 25, 29).

COMPOSITAE. Sunflower Family

Corollas strap-shaped in all the flowers of the head. ----------Tribe 1. *Cichorieae.*
Corollas tubular in all the flowers of the head or strap-shaped only in the marginal ones.
Anther caudate at base. Style-branches neither truncate nor appendaged.
Heads not radiate. ----------Tribe 4. *Inuleae.*
Anthers not caudate at base. Style-branches either truncate or tipped with an appendage.
Heads rayless. Style-branches club-shaped, obtuse. Flowers all perfect and never yellow. ----------Tribe 2. *Eupatorieae.*
Heads radiate, or rarely rayless.
Style-branches of the perfect flowers flat or tipped with a distinct appendage. Leaves mostly alternate. ----------Tribe 3. *Astereae.*
Style-branches of the perfect flowers truncate or appendaged, not flattened. Leaves often opposite.
Involucre scarious. Pappus not capillary. ----Tribe 6. *Anthemideae.*
Involucre not scarious.
Pappus capillary. ----------Tribe 7. *Senecioneae.*
Pappus never capillary.
Receptacle chaffy.
Involucre bracts not enfolding ray-achenes. ---- ----------Tribe 8. *Heliantheae.*
Involucre bracts each enfolding a ray-achene. ----------Tribe 9. *Madieae.*
Receptacle not chaffy. ----------Tribe 5. *Helenieae.*

Tribe 1. *Cichorieae*

Bristles of the pappus (or some of them) plumose. ---------- 1. *Stephanomeria.*
Bristles of the pappus smooth, scabrous, or barbellulate, but never plumose.
Stems scapose, the leaves all basal.
Achenes spinulose-toothed above. ----------2. *Taraxacum.*
Achenes not spinulose-toothed above. ---------- 3. *Agoseris.*
Stems not scapose, more or less leafy. ----------4. *Hieracium.*

Tribe 2. *Eupatorieae*

Involucral bracts in 2 series, nearly equal. Stems simple or with a few branches. ---------- 5. *Eupatorium.*

Tribe 3. *Astereae*

Ray flowers none or yellow (see also Erigeron).
Pappus bristles equal or unequal. Heads medium in size.
Involucral bracts not in definite vertical ranks. ----------6. *Macronema.*
Involucral bracts in definite vertical ranks. ----------7. *Chrysothamnus.*
Pappus bristles equal. Heads radiate, small, very numerous. -------8. *Solidago.*
Ray flowers present, pink, white, blue, or purple, sometimes none in *Erigeron* and *Macaranthera* (or very rarely yellow).
Involucral bracts imbricated in 2 or more series.
Bracts of the involucre in many series, their tips spreading. Ray flowers minute or wanting. ----------9. *Macaranthera.*
Bracts of the involucre in 1-5 series, their tips mostly erect. Ray flowers evident. ----------10. *Aster.*
Involucral bracts in 1 or 2 series, mostly equal. Style branches triangular or oblong, obtuse. ----------11. *Erigeron.*

Tribe 4. *Inuleae*

Achenes bearing stipitate glands. Pappus none. Leaves broad, woolly beneath. ---------- 12. *Adenocaulon.*

Achenes without glands. Pappus present.
Central flowers of pistillate heads sterile. Robust herbs. ---------- 13. *Anaphalis.*
Central flowers of pistillate heads perfect. Low herbs. ---------- 14. *Antennaria.*

Tribe 5. *Helenieae*

Involucral bracts in a single series.
Ray flowers conspicuous or obvious. ---------- 15. *Eriophyllum.*
Ray flowers inconspicuous or none. ---------- 16. *Chaenactis.*
Involucral bracts in 2 or more series. High mountain plants.
Bracts of the involucre erect. ---------- 17. *Hulsea.*
Bracts of the involucre reflexed. ---------- 18. *Helenium.*

Tribe 6. *Anthemideae*

Receptacle with chaff-like bracts. Heads in a terminal corymb. Rays 4 or 5. ---------- 19. *Achillea.*

Tribe 7. *Senecioneae*

Pappus-bristles 15 to 25, short, soft, plumose. Heads solitary, discoid.
Leaves basal, entire. ---------- 20. *Raillardella.*
Pappus-bristles not truly plumose.
Leaves alternate or basal. ---------- 21. *Senecio.*
Leaves all opposite or only the upper ones alternate. ---------- 22. *Arnica.*

Tribe 8. *Helianthеae*

Pappus persistent or none. ---------- 23. *Rudbeckia.*

Tribe 9. *Madieae*

Achenes of rays laterally compressed. ---------- 24. *Madia.*

1. *Stephanomeria* Nutt.

1. *Stephanomeria lactucina* Gray, Proc. Am. Acad. 6: 552. 1865; (11, 25).
Ptiloria lactucina (Gray) Greene, Pittonia 2: 133. 1890; (26).

2. *Taraxacum* Hall.

1. *Taraxacum palustre* (Lyons) Lam. & DC. var. *vulgare* (Lam.) Fernald, Rhodora 35: 380. 1933.

Leontodon taraxacum L., Sp. Pl. 2: 798. 1753; (19, 20, 22, 24, 26, 27).
Taraxacum vulgare (Lam.) Schrank, Prim. Fl. Salisburg. 193. 1792; (25).
Taraxacum officinale Weber in Wiggers, Prim. Fl. Holst. 56. 1780; (1, 10, 11, 12, 15, 31).
Taraxacum taraxacum (L.) Karst., Deut. Fl. 1138. 1880-83; (2, 5, 6, 13, 14, 17).

3. *Agoseris* Raf.

Achenes more or less linear, beakless or tapering gradually into a short and thickish beak on which the nerves or ribs of the body are prolonged to the apex. Pappus rigidulous. Perennial plants from a strong caudex.
Achenes beakless, the moderately short contracted summit of the same texture as the body and equally 10-costate. ---------- 1. *A. alpestris.*
Achenes with the apex tapering gradually into a rather stout and nerved beak which is shorter than the body of the achene.
Scapes glabrous. Leaves mostly glaucous.
Leaves mostly entire. ---------- 2. *A. glauca.*
Leaves laciniately pinnatifid. ---------- 3. *A. glauca* var.
Scapes pubescent. ---------- 4. *A. glauca* var.

Achenes with a slender and mostly filiform nerveless beak and with soft pappus.
Beak of the achene not longer or but little longer than the cylindraceous or narrowly fusiform body. Flowers orange.
Beak of the achene 4-6 mm. long. Pappus somewhat rigidulous. ---------- 5. *A. aurantiaca.*
Beak of the achene 8-10 mm. long. Pappus soft but not flaccid.
Leaves lanceolate to nearly linear. Scape 10-18 inches high. ---------- 6. *A. gracilens.*
Leaves narrowly linear, with a few linear lobes. Plants lower than 10 inches in height. ---------- 7. *A. gracilens* var.
Beak of the achene slender-filiform to almost capillary, 2-4 times as long as the body of the achene. Flowers yellowish. ---------- 8. *A. laciniata.*

1. *Agoseris alpestris* (Gray) Greene, Pitt. 2: 177. 1891; (1, 5, 16, 25).

2. *Agoseris glauca* (Nutt.) Greene, Pitt. 2: 176. 1891; (5, 6, 13, 14, 15, 17, 20, 22, 26, 27, 28, 31).

Troximon glaucum Nutt. in Fras. Catal. 1813; (4, 8, 11).

3. *Agoseris glauca* (Nutt.) Greene var. *laciniata* (Eaton) Smiley, Univ. Calif. Publ. Bot. 9: 404. 1921; (21, 25).

Macrorhynchus glaucus (Nutt.) D. C. Eaton var. *laciniatus* D. C. Eaton in Wats., Bot. King's Exped. 204. 1871.

4. *Agoseris glauca* (Nutt.) Greene, var. *aspera* (Rydb.) Piper, Contri. U. S. Nat. Herb. 11: 542. 1906; (5, 16).

Agoseris Leontodon Rydb. var. *asperum* Rydberg, Mem. N. Y. Bot. Gard. 1: 457. 1900; (2).

Agoseris aspera Rydb., Rocky Mts. 1030. 1917; (22).

5. *Agoseris aurantiaca* (Hook.) Greene, Pitt. 2: 177. 1891; (1, 2, 5, 6, 15 ,16, 17, 20, 21, 26).

Troximon aurantiacum Hook., Fl. Bor. Am. 1: 300. pl. 104. 1834; (4, 88, 11).

6. *Agoseris gracilens* (Gray) Kuntze, Rev. Gen. Plant. 1: 304. 1891; (2, 6, 20, 25, 26).

Agoseris gracilenta (Gray) Greene, Pitt. 2: 177. 1891; (1, 5, 15, 16).

7. *Agoseris gracilens* (Gray) Kuntze var. *Greenei* (Gray) Blake, Contrib. U. S. Nat. Herb. 25: 629. 1925.

Agoseris Greenei Rydb., Mem. N. Y. Bot. Gard. 1: 459. 1900; (2, 17).

Agoseris graminifolia Greene, Bull. Torr. Bot. Club 25: 124. 1898; (20).

8. *Agoseris laciniata* (Nutt.) Greene, Pitt. 2: 178. 1891; (1, 5, 15, 17, 20).

Stylopappus laciniatus Nutt., Trans. Am. Phil. Soc. 7: 432. 1841.

4. *Hieracium* L.

Flowers white. ---------- 1. *H. albiflorum.*
Flowers yellow.
Basal leaves glabrous. ---------- 3. *H. gracile.*
Basal leaves not glabrous.
Crinite-hirsute with long and whitish or yellowish shaggy denticulate hairs, especially on both sides of the entire leaves, on the branching leafy stems and panicle; involucre long-hirsute. ---------- 2. *A. relicinum.*
Not crinite, (rarely with scattered bristles on the involucre and panicle), but at least the radical leaves and base of stem sparsely or evenly thickly setose-hirsute with long spreading hairs.
Heads 15-30 flowered. Achenes not over 3 mm. long.
Leaves 2-several on the stem. ---------- 4. *H. cynoglossoides.*

Leaves all in a basal tuft, or only 1 or 2 very small, and bracteiform leaves on the stem. ----------5. *H. cynoglossoides* var.
Heads 5-15 flowered. Achenes fully 4 mm. long. ------6. *H. Greenei.*

1. *Hieracium albiflorum* Hook., Fl. Bor. Am. 1: 298. 1834; (1, 2, 5, 6, 8, 10, 11, 12, 13, 15, 16, 20, 21, 22, 24, 25, 26).

2. *Hieracium relicinum* Fries, Epicr. Gen. Hierac. 153. 1862.

Gray (Syn. Fl. 1: 427. 1888) states that this species is only a taller and simpler-stemmed form of *H. horridum,* with widely open panicle and long-hirsute involucre.

3. *Hieracium gracile* Hook., Fl. Bor. Am. 1: 298. 1834; (1, 2, 4, 5, 6, 8, 13, 15, 16, 17, 20, 22, 26).

4. *Hieracium cynoglossoides* Arvet-Touv., Spicel. Hier. 20. 1881; (1, 2, 5 ,8, 15, 16, 20, 25).

5. *Hieracium cynoglossoides* Arvet-Touv. var. *nudicaule* Gray, Proc. Am. Acad. 19: 68. 1883; (19, 21).

6. *Hieracium Greenei* Gray, Proc. Am. Acad. 19: 69. 1883; (25).

5. *Eupatorium* L.

1. *Eupatorium occidentale* Hook., Fl. Bor. Am. 1: 305. 1834; (1, 5, 11, 12, 20, 21, 25, 26).

6. *Macronema* Nutt.

1. *Macronema Greenei* (Gray) Greene, Erythea 2: 73. 1894; (1, 25).

The form at Crater Lake verges toward the variety *mollis* of Gray. Intergrading specimens connecting the specific with the varietal form are so common that many authors reduce the variety to a synonym of the species.

7. *Chrysothamnus* Nutt.

1. *Chrysothamnus nauseosus* (Pall.) Britt. var. *speciosus* (Nutt.) Hall & Clements, Phylog. Meth. Taxon. 211. 1923; (25, 30).

Chrysothamnus speciosus Nutt., Trans. Am. Phil. Soc. n. ser. 7: 324. 1841; (1, 20, 26).

8. *Solidago* L.

1. *Solidago elongata* Nutt., Trans. Amer. Phil. Soc. n. ser. 7: 327. 1841; (1, 5, 10, 13, 15, 16, 20, 22, 25, 26, 27, 28).

This species is close to *S. californica* Nutt. *S. californica* has a fine-grayish pubescence, the individual hairs of which are disposed to be wavy and extending in all directions. The pubescence of the leaves of our species when present at all is composed of stout, stiff hairs which are not wavy, and which are inclined to lie in one direction. This distinction of pubescence is only to be seen by a lens. The leaves of *S. californica* are blunter and more oblanceolate, while those of our species are usually sharper and more acuminately tipped. Also *S. californica* is not known from our locality.

9. *Macaranthera* Nees

1. *Macaranthera eradiata* Howell, Fl. Northwest Am. 314. 1897; (1).

Aster leucanthemifolius Greene, Erythea 3: 119. 1895; (26).

Macaranthera viscosa (Nutt.) Greene, Pitt. 4: 22. 1899; (8, 17, 20).

Macaranthera canescens Gray var. *viscosa* (Nutt.) Piper, Contrib. U. S. Nat. Herb. 11: 515. 1906; (5, 13).

Nelson and Macbride have described *M. inops* from "Glacier Mountain, in the Crater Lake region" and also *M. inops* var. *atrata* from the "summit of Llao Rock" (Bot. Gaz. 62: 148. 1916). The descriptions are too indefinite for positive determination and we have not seen the type material.

10. *Aster* L.

Ray flowers few, usually not more than 8. ——2. *A. Engelmanni* var.
Ray flowers more than 8.
Involucre viscid or pruinose-glandular. ——1. *A modestus.*
Involucre not viscid nor glandular. ——3. *A. Fremonti.*

1. *Aster modestus* Lindl. in Hook., Fl. 2: 8. 1834; (1, 15).

2. *Aster Engelmannii* Gray, var. *ledophyllus* Gray, Proc. Am. Acad. 8: 388. 1872.

Eucephalus ledophyllus (Gray) Greene, Pitt., 3: 55. 1896; (1, 5, 16).
Eucephalus Covillei Greene, Pitt. 3: 162. 1897; (1).

3. *Aster Fremonti* Gray, Syn. Fl. N. Am. 1: 191. 1884; (1, 2, 4, 5, 8, 11, 13, 15, 20, 21, 22, 24, 26).

Aster adscendens Lindl. var. *Fremonti* Torr. & Gray, Fl. N. Am. 2: 503. 1843; (25).

11. *Erigeron* L.

Leaves mostly in a dense basal tuft. Dwarfed species of high mountains.
Herbage hirsute. The leaves, at least the basal, dissected. ——1. *E. compositus.*
Herbage not hirsute, at most merely conescent. Leaves not dissected. ——2. *E. peucephyllus.*
Leaves not mostly in a dense basal tuft. Taller herbs.
Rays inconspicuous, filiform. ——3. *E. acris* var.
Rays conspicuous. ——4. *E. salsuginosus.*

1. *Erigeron compositus* Pursh, Fl. Am. Sept. 2: 535. 1814; (1, 4, 5, 8, 11, 13, 14, 15, 20, 22, 24, 26, 31).

2. *Erigeron peucephyllus* Gray, Proc. Am. Acad. 16: 89. 1880; (20, 25, 26, 31).

Erigeron filifolius Nutt., Trans. Am. Phil. Soc. N. S. 7: 308. 1811, of western authors; (5).

3. *Erigeron acris* L. var. *debilis* Gray, Syn. Fl. 1: 220. 1884; (5, 8, 15, 16, 26).

Erigeron jucundus Greene, Pittonia 3: 165. 1897; (20, 22, 31).

4. *Erigeron salsuginosus* (Richards.) Gray, Proc. Am. Acad. 16: 93. 1881; (2, 4, 5, 6, 8, 11, 14, 16, 17, 18, 20, 21, 25, 26, 28).

12. *Adenocaulon* Hook.

1. *Adenocaulon bicolor* Hook., Bot. Misc. 1: 19. t. 15. 1830; (1, 5, 10, 11, 13, 15, 16, 20, 22, 25, 31).

13. *Anaphalis* DC.

1. *Anaphalis margaritacea* (L.) Benth. & Hook. var. *subalpina* Gray, Syn. Fl. 1: 233. 1884; (5, 15, 16, 26).

Anaphalis subalpina (Gray) Rydb., Mem. N. Y. Bot. Gard. 1: 415. 1900; (2, 8, 17, 20, 30).

14. *Antennaria* Gaertn.

Involucral bracts pink or reddish.
Plants low, about 4 inches high. Inflorescence paniculate or somewhat spicate or cymose. Stems leafy above. ----------5. *A. Geyeri.*
Plants taller. Inflorescence cymose. Stems sparsely leafy above. 4. *A. dioica* var.
Involucral bracts not reddish.
Tips of the involucral bracts green, pale brown or scarious.
Plants 6-20 inches high. ----------1. *A. racemosa.*
Plants under 6 inches high. ----------2. *A. alpina.*
Tips of the involucral bracts pearly white. ----------3. *A. dioica.*

1. *Antennaria racemosa* Hook., Fl. Bor. Am. 1: 330. 1834; (1, 2, 4, 5, 6, 8, 13, 15, 16, 20, 22).

2. *Antennaria alpina* (L.) Gaertn., Fr. & Sem. 2: 410. 1791; (20, 25).

3. *Antennaria dioica* (L.) Gaertn., Fr. & Sem. 2: 410. pl. 167, f. 3. 1791; (25).

4. *Antennaria dioica* (L.) Gaertn. var. *rosea* DC. Eaton in King, Geol. Expl. 40th Par. 5: 186. 1871, nomen nudum.

Antennaria rosea (Eaton) Greene, Pittonia 3: 281. 1898; (1, 5, 6, 8, 11, 13, 14, 15, 16, 20, 21, 22, 26, 31).

5. *Antennaria Geyeri* Gray, Mem. Am. Acad, n. ser. 4: 107. 1849; (1, 5, 13, 26).

15. *Eriophyllum* Lag.

1. *Eriophyllum multiflorum* (Nutt.) Rydb., Mem. N. Y. Bot. Gard. 1: 422. 1900; (5, 12, 13, 20).

16. *Chaenactis* DC.

Plants 6-24 inches high. ----------1. *C. Douglasii.*
Plants dwarfed, 3-5 inches high. ----------2. *C. Douglasii* var.

1. *Chaenactis Douglasii* (Hook.) Hook. & Arn., Bot. Beech. Voy. 354. 1840; (1, 2, 5, 8, 10, 11, 13, 15, 17, 20, 21, 25, 26, 27, 31).

2. *Chaenactis Douglasii* (Hook.) Hook. & Arn. var. *alpina* Gray, Syn. Fl. 1: 341. 1884; (1, 25).

Chaenactis nevadensis (Kellogg) Gray, Bot. Calif. 390. 1876; (26).

Chaenactis alpina (Gray) Jones, Proc. Calif. Acad. Ser. II. 5: 699. 1895; (2, 20).

17. *Hulsea* Torr. & Gray

1. *Hulsea nana* Gray in Torr., Pacif. R. R. Rep. 6: 76. 1857; (1, 5, 12, 16, 25).

18. *Helenium* L.

1. *Helenium Bigelovii* Gray, Pac. R. R. Rep. 4: 107. 1857; (1, 10, 11, 12, 14, 21, 25).

19. *Achillea* L.

1. *Achillea millefolium* L. var. *lanulosa* Piper, Mazama 2: 97. 1901; (5, 13, 16, 21, 25, 27).

Achillea lanulosa Nutt., Jour. Acad. Phila. 7: 36. 1834; (2, 4, 6, 15, 17, 19, 20, 22, 24, 26, 31).

20. *Raillardella* Gray

1. *Raillardella argentea* Gray, Proc. Am. Acad. 6: 550. 1865; (1, 11, 21, 24, 25).

21. *Senecio* L.

Stems leafy to the top. ---------- 1. *S. triangularis.*
Stems not leafy to the top, or the stem leaves much reduced.
Plants normally over 1 foot high. Leaves glabrous or sparsely villous when young. ---------- 2. *S. exaltatus.*
Plants normally less than 1 foot high. Leaves with a dense white tomentum. ---------- 3. *S. canus.*

1. *Senecio triangularis* Hook., Fl. Bor. Am. 1: 332. 1834; (1, 4, 5, 6, 11, 13, 15, 16, 17, 20, 21, 22, 24, 25, 26, 27).

Senecio Gibbonsii Greene, Pitt. 3: 20. 1889; (1).

2. *Senecio exaltatus* Nutt., Trans. Am. Phil. Soc. 7: 410. 1841; (1, 2, 5, 13, 15, 16, 20).

Senecio lugens Richards. var. *exaltatus* (Nutt.) Gray, Bot. Calif. 1: 413. 1876; (21).

3. *Senecio canus* Hook., Fl. Bor. Am. 1: 333. 1834; (4, 5, 6, 8, 11, 15, 20, 22, 25, 31).

This species is very close to *S. Howellii;* but the characters of both species are so variable that some botanists doubt the validity of the latter. According to the treatment of Gray and Jepson, our species is to be referred to *S. canus.* Greenman does not concur with these authors.

22. *Arnica* L.

Basal leaves broad, truncate at base of blade, long-petioled. ---------- 1. *A. cordifolia.*
Basal leaves narrow, mostly short-petioled.
Heads rayless. ---------- 2. *A. Parryi.*
Heads radiate.
Leaves oblong or oblong-lanceolate, remotely denticulate. Lower stem leaves not with conspicuous sheaths. ---------- 3. *A. Chamissonis.*
Leaves entire or subentire, narrowly lanceolate. Lower stem leaves with conspicuous sheaths. ---------- 4. *A. longifolia.*

1. *Arnica cordifolia* Hook., Fl. Bor. Am. 1: 331. 1834; (1, 2, 4, 5, 6, 8, 11, 13, 14, 15, 16, 17, 19, 20, 21, 22, 24, 25, 26, 27, 28, 31).

This species presents a variety of forms.

2. *Arnica Parryi* Gray, Am. Nat. 8: 213. 1874; (1, 4, 5, 8, 15, 20, 22, 26).

3. *Arnica Chamissonis* Less., Linnaea 6: 238. 1831; (1, 2, 4, 6, 11, 15, 20).

Arnica mollis Hook., Fl. Bor. Am. 1: 331. 1834; (5, 16, 20, 25).

Some authors recognize *A. mollis* as being distinct, but we have not been able to verify the separatory points in Crater Lake material.

4. *Arnica longifolia* DC. Eaton in Wats., Bot. King Explor. Exped. 186. 1871; (1, 2, 5, 11, 20, 21, 22, 25, 26).

23. *Rudbeckia* L.

1. *Rudbeckia occidentalis* Nutt., Trans. Am. Phil. Soc. 7: 355. 1841; (1, 2, 5, 8, 12, 13, 20, 25, 26).

24. *Madia* J. I. Molina

1. *Madia Bolanderi* Gray, Proc. Am. Acad. 8: 391. 1872; (11, 25).

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INDEX

A New Fairy Shrimp Belonging to the Genus Pristicephalus *

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Near Tiptonville, Tennessee, in the Reelfoot Lake region, on April 13, 1936, a collection was made of 39 individuals on an anostracan phyllopod. Upon examination they proved to be representatives of the genus *Pristicephalus* Daday (1910), a genus not well established for North America. Daday characterized the genus as follows:

> Body more or less robust, dimensions variable. Abdominal trunk long without prominent processes. Abdomen in both sexes slender, in male unarmed, in female turned under, at times armored. Cercopods movable, ensiform, articulation distinct from last abdominal segment, margin setaceous.
>
> Head very little compressed, front unarmed. Lower antennae of male biarticulate; basal articulation frequently bladder-like, on top side near the base is a serriform appendage, its margin spiny, distal end gradually attenuates; apical joint frequently possesses at its inside base a smooth, nearly straight process without a bend.
>
> Feet all have similar structure, endopodite in lower angle is posteriorly abbreviated, broadly rounded.
>
> Apical joint of penis strongly pointed, external margin terminating in serrated tooth.

With one exception this genus is restricted to the temperate regions of Europe and Asia and northern Africa. The only record for North America is that of *P. bundyi* (Forbes), Creaser (1935), which was placed in the genus *Eubranchipus* by the original author.

In view of the present investigation the name *Pristicephalus comptus* is here proposed for the species recently found in the Reelfoot lake region.

Pristicephalus comptus sp. nov.

Male.— The body is relatively slender and is unarmed. The long abdomen has 7 postgenital segments. The cercopods (Fig. 9) are long (length about 1.4 mm.), lanceolate and slightly ensiform, bearing feather-like setae on both the inner and outer margins.

The head (Fig. 2) is broadly rounded with the front unarmed, first antenna is long and slender, the second or clasping antenna is biarticulate. The basal joint is moderately large and heavy, the terminal segment is sickle-shaped, smooth and forked, the shorter branch about one-third the length of the longer. The longer branch is uniformly curved and crosses its mate when in repose. Total average length of clasping antenna about 3.1 mm. Near the base and on the top of each clasping antenna there arises a prehensile

*Contribution from the Zoological Laboratory of the University of Illinois. No. 490.

organ (Fig. 2). Normally these organs are coiled in front of and between the clasping antenna (Fig. 3). The cylindrical prehensile organs may be divided into three regions. The first third is fringed medially by lamelliform processes varying in number from 6 to 10 as well as several small median spines. the second third bears medially 4 to 6 digitiform, spinulated processes and the gradually attenuated distal third is thickly studded with many small spines. The total average length of the extended prehensile organ is about 4.0 mm., less than one third longer than the clasping antennae.

The 11 pairs of swimming legs (Fig. 7) all have the same general structure. The first endite is much reduced, very broadly rounded and fringed with long, curved, feather-like setae. Endites 2 to 4 are small, short and bear 2 to 4 short spines as well as 1 to 3 long setae. The fifth endite is very broad and with the exception in the male first leg (Fig. 5) is fringed by long setae. The sixth endite is elongate, obtuse at the end and fringed by setae. The gill is normal and the flabellum is bilobed in the form of two branchial laminae.

The external genitalia (Figs. 6 & 10) extend over the length of three and one half abdominal segments. The median, ventral protuberances are rounded and possess median serrations. The retractile cirrus when extended is curved, serrated and ensiform.

The total length of the body varies from 8.6 to 10.8 mm., the average length being 9.8 mm.

Female.—The unarmed body is similar to that of the male, and has postgenital segments; the cercopods are also similar.

The broadly rounded, unarmed head (Fig. 1) possesses long, narrow first antennae. The second antennae are bilobed with a longer than usual mucronate process, the inner margin is deeply cleft with a long, pointed median process, the dorsal and outer edges are fringed with setae.

The 11 pairs of swimming feet (Fig. 7) are similar to those of the male. The fifth endite of the first foot (Fig. 4) is not as broad as that of the male and is fringed by longer setae, the sixth endite is not as long or as obtuse as that of the male.

The ovisac (Fig. 8) is short and heavy, extending over three and one half abdominal segments, the ventral opening is very rounded and has two prominent lips. The number of eggs varies from 15 upward, depending on the maturity of the animal.

The total body length varies from 10.3 to 11.5 mm.; the average length is 11.0 mm.

The only North American Anostraca which may be confused with *P. comptus* is *Branchinella holmani* (Ryder). As pointed out by Creaser (1930) the status of this species is uncertain. The descriptions and figures of Ryder (1879) and Packard (1883) are inadequate for accurate comparison. Since

no specimens of *B. holmani* are available direct comparison is impossible. However, the important differences are in the prehensile organs and second antennae. In *B. holmani* the terminal segment of the second antenna is longer than the first segment, the short branch of the terminal segment of the clasper is rough, there are 7 papilliform processes on the first third of the prehensile organ, 7 digitiform processes on the second third, the total length of the prehensile organs is 3 times that of the claspers, the male averages 15 mm. in length and the female 16 mm. *P. comptus* has a biarticulate clasper with segments of nearly the same length, the short branch of the terminal segment smooth, the lamelliform processes varies from 6 to 10 with 8 as the average, there are never more than 6 digitiform processes, the total length of the prehensile organs is less than one third longer than that of the claspers, the male averages 9.8 mm. and the female 11.0 mm. in length.

Due to the general similarity between these two forms it is the opinion of the author, based on Ryder's and Packard's descriptions, that *B. holmani* should probably be placed in the genus *Pristicephalus*. However, because the type specimens have been lost and no specimens are known for this species an accurate determination can not be made.

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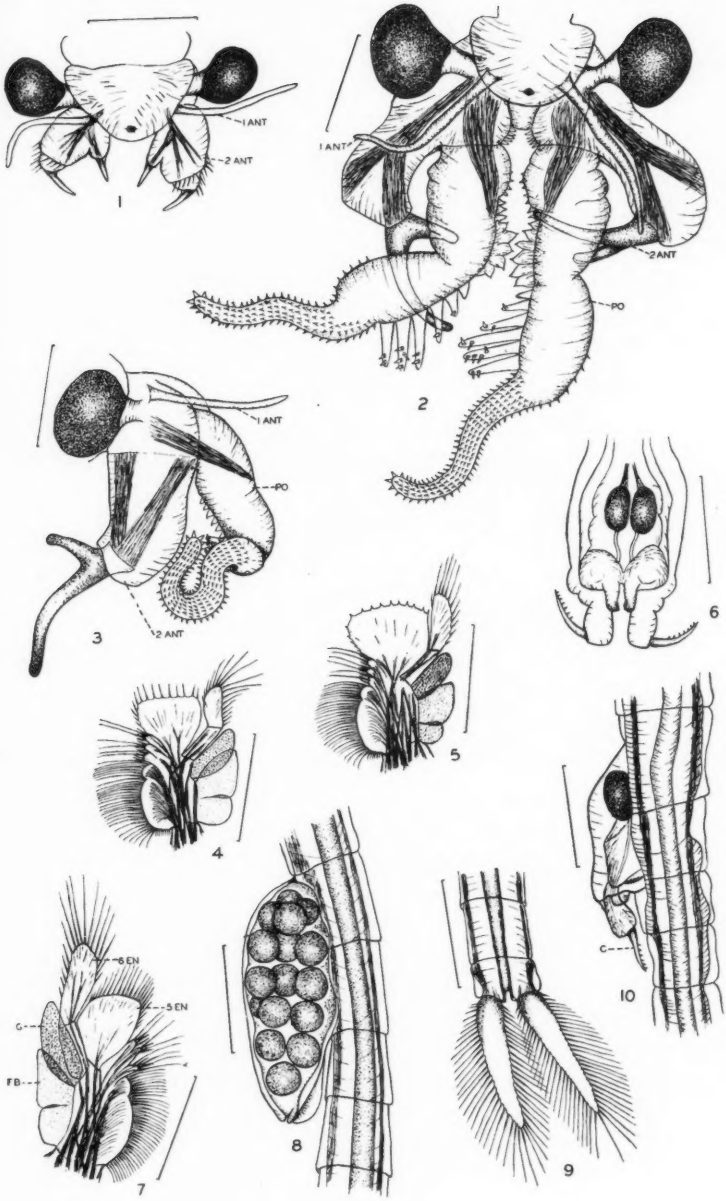
EXPLANATION OF PLATE

Figures: 1. Dorso-frontal view of female head. (1 ant) first antenna; (2 ant) second antenna.—2. Dorso-frontal view of male head. (po) prehensile organ.—3. Lateral view of male head.—4. First leg of female.—5. First leg of male.—6. Ventral view of male genitalia.—7. Tenth leg of female. (5 en) fifth endite; (6 en) sixth endite; (g) gill; (fb) flabellum.—8. Lateral aspect of ovisac.—9. Dorsal aspect of cercopods.—10. Lateral aspect of male genitalia. (c) cirrus.

All Camera lucida outline. Scale 1 mm. in all Figures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Two New Ectoparasitic Trematodes from the Sting Ray, Myliobatus californicus

John E. Guberlet

The material upon which this study is based was obtained from G. E. MacGinitie, of the California Institute of Technology. These trematodes were collected from sting rays on July 20, 1927, taken in Elkhorn Slough, a salt water estuary of Monterey Bay. The worms, both as alcoholic specimens and as balsam mounts, were referred to me in August, 1934. An examination of the material revealed two distinct genera of ectoparasitic trematodes belonging to rather widely separated families, *Tristomidae* Taschenberg (1879) and *Udonellidae* Van Beneden and Hesse (1863). The writer wishes to make grateful acknowledgement to Mr. MacGinitie for the privilege of examining and describing this material.

Material

Two specimens of *Epibdella* mounted in balsam were received from Mr. MacGinitie. These were removed from the slides and one was restained and remounted in balsam; the other was sectioned and stained with Delafield's haematoxylin and eosin. Twelve specimens of *Calinella* were presented for study of which some were balsam mounts and the rest were in alcohol. Some of these were stained with paracarmine and mounted *in toto* while the others were sectioned and stained with Delafield's haematoxylin and counterstained in eosin.

Classification

There are some differences in classification of monogenetic trematodes as proposed by Poche (1925) and Fuhrmann (1928), however, the agreement between these two authors is fairly close as far as the forms under consideration are concerned. The system as adopted by Fuhrmann seems more logical in this particular instance.

Order Monogenea Van Beneden, 1861.

1. Sub-order: Monopisthodiscinea Fuhrmann.
2. Sub-order: Monopisthocotylinea Odhner.
   - Family: Monocotylidae Taschenberg (1879).
     Anterior end without sucking grooves, in their place are groups of cells opening outward.
   - Family: Tristomidae Taschenberg (1879).
     Anterior end with two lateral sucking discs or sucking grooves.

* Contribution from the Departments of Zoology and Oceanography, University of Washington, Seattle.

Sub-family: ANCYROCOTYLINAE Monticelli.
Posterior sucker without septa.
Genus: *Epibdella* Blainville.
Sub-family: TRISTOMINAE Monticelli.
Posterior sucking disc with septa.
Family: UDONELLIDAE Van Beneden and Hesse.
Elongate, cylindrical, ectoparasitic trematodes with two anterior sucking discs. The posterior adhesive organ a sucker-like adhesive disc, unarmed. Pharynx well developed, protrusible. Intestine forked or simple sack-shaped. Genital openings median. Vagina absent. One or two testes. Copulation organ absent. Eggs with appendages. Live on the body surface of parasitic crustaceans on marine fishes.
Genus: *Calinella* Monticelli, (1910).

Epibdella pacifica sp. nov.

The two worms upon which this study was based were about 4 mm. in length and 2 mm. in width (Fig. 1). A pair of sucking grooves is situated at the anterior end in front of the mouth. They measure between 0.5 and 0.6 mm. in length and 0.4 mm. in breadth. Each one is marked on the inner surface by ten or twelve minute longitudinal grooves. At the posterior end the body is rather abruptly constricted to a slender pedicel at the point of attachment to the posterior fixation disc. The posterior fixation disc is circular in outline and measures approximately 2 mm. in diameter. Two pairs of hooks situated on the ventral surface near the posterior edge arm the adhesive disc. The hooks of the larger pair are slightly curved and measure approximately 0.5 mm. in length while the hooks of the smaller pair are minute, about 0.08 mm. in length, and are situated median to the bases of the larger pair. Both pairs of hooks have their origins near the center of the disc. In nearly all species of *Epibdella* reported in the literature three pairs of hooks invariably occur on the posterior adhesive disc. However, Linton (1901, 286) observed only two pairs in *E. bumpusii*. Numerous, irregularly arranged, minute papillae cover the entire ventral surface of the disc, similar to that shown by Van Beneden (1861, 22) for *E. hippoglossi* (O. F. Muller).

Digestive system.—As in many monogenetic trematodes the digestive system consists of three parts, pharynx, esophagus and intestine (Fig. 2). The pharnyx with the mouth opening is globular in shape and measures about 0.5 mm. in diameter. It is a muscular organ and partially enclosed within a membraneous sheath. In the present form the pharynx is very similar to that shown by Heath (1902) for *E. squamula* Heath and by Goto (1895) for *E. ishikawae* Goto. The mouth opening may be directed anteriorly or ventrally. A small pharyngeal sheath or pocket is situated behind the pharynx which is joined to the branches of the intestine by a very short esophagus. The branched intestine bears a strong resemblance to that of *E. steingroveri* Cohn as shown by Cohn (1916), to *E. ovata* as figured by Goto (1895) and to *E. squamula* of Heath (1902). However, in the material under observation there is no branching of the esophagus as described for *E. squamula*. The

two intestinal caeca bear many lateral branches which ramify throughout the mesenchyme mass. Median branches are few in number but a pair is present immediately in front of the testes and two or three pairs are given off behind them.

Male Reproductive Organs.—The two testes are oval shaped organs and are situated in about the middle of the body. Each is encased in a connective tissue sheath. On either side the intestinal caeca lie against the testes (Fig. 3). The testes measure about 0.8 mm. in length and from 0.35 to 0.5 mm. in width. A pair of vasa efferentia arise from the medial surfaces near the anterior ends of the testes. These soon fuse to form the vas deferens which continues forward to the ovary and then proceeds in a latero-anterior direction to the region of the vagina. Here the vas deferens turns abruptly and passes transversely to the opposite side where it becomes convoluted and again turns upon itself and traverses a nearly parallel course to the region in front of the vagina. The vas deferens then proceeds anteriorly and enters the base of the cirrus.

The cirrus is a muscular organ about 0.7 mm. in length and approximately 0.06 mm. in thickness. This is enclosed in a sac or pouch which allows for its movement. Attached to the base of the cirrus is the prostate gland which lies transversely across the body immediately behind the pharynx. It may be a long, slightly triangular organ or it may be a convoluted tubular structure measuring approximately 0.3 mm. in length and about 0.1 mm. in width.

Female Reproductive Organs.—The ovary is irregularly oval in shape and measures approximately 0.3 to 0.4 mm. in length by about 0.2 mm. in maximum width. It is situated immediately in front of the testes and slightly to one side of the median line. The oviduct arises from the dorsal anterior margin of the ovary. There is some indication of an intra-ovarian seminal receptacle which will be discussed elsewhere. As the oviduct proceeds anteriorly it receives the yolk duct almost immediately and continues to the ootype and shell gland which is located directly posterior to the pharynx. The ootype is an elliptical-shaped, muscular organ and within its walls are many large cells which comprise the shell gland. Together, the ootype and shell gland show measurements of approximately 0.27 by 0.1 mm. A short uterus passes laterally from the ootype and unites with the envesting sheath of the cirrus to form a genital atrium before opening to the exterior as the genital pore.

The vagina (Fig. 3) opens to the exterior as a pore on the ventral surface a short distance behind the genital opening and passes as a narrow tube toward the median line and posteriorly to unite with the yolk reservoir. Shortly before the external opening is reached, the vagina becomes enlarged and thick walled to form a vesicle-like organ.

The yolk glands or vitellaria are widely scattered throughout the whole animal, filling all available space over and between the branches of the digestive tract. Behind the testes they fill a portion of the space between the intestinal caeca and extend to the region near the posterior end of the animal. Some space in the posterior end near the point of attachment with the ad-

hesive disc is free from yolk glands. In the head region in front of the pharynx only a few yolk follicles are present unlike the condition shown by Layman (1930) for *E. derzhavini*. The yolk follicles are small and the cells exhibit various degrees of development. Small tubules arising from each follicle fuse until they unite into large ducts in both lateral fields. The large yolk duct from each side passes to the median line where they fuse to form a large vitelline reservoir immediately in front of and slightly to one side of the ovary. A single vitelline duct arises from the posterior part of the reservoir and leads to the oviduct.

The eggs (Fig. 4) are comparatively large, have thick brown shells and bear a single polar filament. Only a few eggs could be obtained for observation so detailed studies could not be made. Available eggs measured 0.17 by 0.14 mm. in size with the filament showing a length of approximately 0.12 mm. The filament terminates in a pad or adhesive disc.

Intra-ovarian seminal receptacle.—There is some evidence from the sections that there is an intra-ovarian seminal receptacle (Fig. 3), somewhat similar to that recorded for *Epibdella melleni* MacCallum by Jahn and Kuhn (1932) and also bearing some resemblance to the ovarial pouch described by Cohn (1916). In the present study the structure does not appear as clearly defined but there is a distinct cavity in the ovary at the base of the oviduct. It could not be determined clearly whether this is simply an enlargement of the opening into the oviduct or whether it is an evagination of the oviduct into the ovary. Lack of material prevents detailed observations on this point.

Organs of problematic nature.—On either side of the posterior lateral regions of the ovary and immediately in front of the testes is a pair of irregularly shaped organs (Figs. 3, 5). Whether they are associated in any way with the reproductive system, it is impossible to state. Each body is composed of a delicate meshwork with finely granular protoplasm without vacuoles but with large, sharply defined nuclei. The left mass is slightly larger than the right and contains about fifteen nuclei while the other has ten. They are slightly lobed and appear as syncytial masses, there being no traces whatever of cell boundaries (Fig. 6). The nuclei possess nucleoli and also show a loose chromatin network. There is a marked difference between the nuclei of the syncytium (Fig. 7) and those of mature (Fig. 9) and immature ova (Fig. 8) in the ovary. No function can be attributed to these organs.

Similar organs have been recorded by Goto (1895, 103) in *Epibdella ovata* Goto, by Heath (1902,117) in *E. squamula* Heath, by Cooper (1921,5) in *E.hippoglossi* Muller, and by Folda (1928,200) in *Megalocotyle marginata* Folda. However, in each of the above instances these organs occur behind the testes rather than in front as in the present case. The above authors refer to them as "organs of problematic nature," or as "polynucleate giant cells." From the descriptions of these organs by the above authors it appears that there is a marked resemblance to the structures under consideration here. An opportunity was afforded to compare the "problematic organs" of *Megalocotyle marginata* with the material under observation in the present study.

There is a striking similarity in the cytoplasmic masses in the two organisms while the nuclei appeared to be identical. Similar staining reactions occurred in both cases. However, the masses are larger in *Epibdella pacifica* than in *Megalocotyle marginata* and they are located in front of the testes in the former and behind in the latter. In all probability the organs under observation here are similar in structure to those described by Goto, Heath, Cooper and Folda. Lack of material prevents a more comprehensive study.

Nervous system.—Eyes could not be seen on the specimens under observation. No attempt was made to determine the structure of the nervous system on account of the lack of material.

Discussion

Epibdella pacifica has a number of points in common with other species of this genus but it also has certain structures which mark it as a distinct form. It is similar in many respects to *E. ishikawae* Goto but it disagrees in the shape and structure of the prostate gland and in the possession of only two pairs of hooks whereas Goto's form has three pairs. It is in agreement with *E. steingroveri* Cohn in regard to the branching nature of the intestine, but differs in regard to the hooks on the adhesive disc. *E. pacifica* differs from *E. derzhavini* Layman in the distribution of vitellaria and the fringe on the adhesive disc. The form under consideration agrees with *E. bumpusii* Linton in the possession of only two pairs of hooks, but there is a distinct disagreement in their size. There is also a marked difference with relation to the reproductive organs, particularly, in the position of the prostate and the distance between the ovary and testes. A thorough consideration of the above factors shows distinctly that *Epibdella pacifica* must be designated as a new species.

Genus and species: *Epibdella pacifica* sp. nov.
Host: *Myliobatus californicus.*
Locality: Monterey Bay, California.

Calinella myliobati sp. nov.

Twelve specimens of this worm were submitted for study. Upon arrival several of the worms attached to the copepod, *Trebius caudatus,* had been prepared as balsam mounts and others were in alcohol. The balsam mounts were removed from the slides and the material was restained and remounted. A few of the worms were sectioned serially and stained. Upon preservation the worms were in various degrees of contraction and therefore presented some difficulty when studies were undertaken.

Generic diagnosis according to Monticelli (1910): Body elongate, cylindrical; anterior end with lips or lobes surrounding the buccal cavity; two small anterior suckers, one on either side of mouth; posterior sucker without hooks; prepharynx poorly developed; pharynx elongate, tubular, strong and protrusible; esophagus absent; intestine sac-like; genital pore anterior and ventral; single testis in middle of body; ovary in front of testis; vitellaria in a mass or layer surrounding intestine. Eggs oval with a polar filament. Habitat :On copepods parasitic on fishes.

The worms are cylindrical and range in size from 0.5 to 1.25 mm. in length and from 0.1 to 0.3 mm. in diameter depending upon the degree of contraction (Fig. 10). Externally, the body has the appearance of being slightly ringed, a characteristic occurring in a number of the members of the family Udonellidae as indicated by Pratt (1900,649) and by Van Beneden and Hesse (1863,89). The mouth is terminal and slightly ventral. Small lip-like protuberances, five or six in number, are situated around the mouth. Small suckers or discs are situated on either side of the mouth. These measure from 0.02 to 0.06 mm. in diameter according to the degree of contraction of the worm. The posterior adhesive disc or sucker is circular in outline, unarmed and approximately 0.1 mm. in diameter.

Digestive system.—The digestive tract is identical with that of *Calinella craneola* as shown by Monticelli (1910). A subterminal mouth opens into the oral cavity which is bounded posteriorly by the large tubular pharynx. This organ is capable of considerable expansion and contraction as it is strong and muscular. In extended specimens it may show a size of 0.12 by 0.05 mm. The organ tapers at each end, is unarmed, mobile and can be protruded through the mouth. When the pharynx is at rest, it lies in a pouch formed by a cul-de-sac of the intestine. An esophagus is entirely lacking. The intestine is a single tubular, more or less, sac-like organ which extends nearly to the posterior end of the animal. Short, columnar cells filled with brown, pigmented granules comprise the lining of the digestive tract. This gives the whole intestine a very decided brown, pigmented appearance which is in accord with *Calinella craneola* Monticelli.

Male Reproductive Organs.—The single testis is ventral and is located in about the middle of the body where it is partially enclosed in an invagination of the intestine (Figs. 10, 11). Considerable variation in size and shape is obtained on account of contraction and expansion of the worms. In a medium sized, well extended individual the testis measured approximately 0.08 mm. in length and 0.07 mm. in width; contracted worms show this organ to be broader than long. The vas deferens was not observed. Two bodies could be seen near the genital pore whose structure and function could not be distinctly determined. One is a pouch opening off from the genital sinus having a length of 0.07 mm. and is considered to be a seminal vesicle. The other is a slightly smaller pouch which arises as a diverticulum from the posterior margin of the first. This is tentatively considered to be a prostate pouch. Immediately adjacent to the so-called prostate pouch is a large mass of cells which possess prominent nuclei and have a fine granular texture. The cell boundaries are not distinctly defined so that the entire structure has somewhat the nature of a syncytium. This, in all probability, is the prostate gland. No cirrus or muscular structure is present in connection with the male organs.

Female Reproductive Organs.—The ovary is a spherical or oval-shaped organ situated directly in front of the testis. In a medium sized, well extended individual, it showed a size of approximately 0.05 mm. in diameter. Contracted specimens showed this organ to be broader than long. A broad ovi-

duct arises from the left ventral surface of the ovary and almost immediately receives the yolk duct after which it proceeds in an anterior-medial direction to enter the ootype. The ootype is made up of two sections, the first is an oval, thick-walled structure and the other a large thin-walled portion which leads to the genital atrium. The latter part might be designated as the uterus. Surrounding the first part and posterior to the uterine portion is a large mass of cells comprising the shell gland. Dorsal to the ootype and anterior to the shell gland lies the large, so-called prostate gland. The ootype, shell gland and prostate gland are all combined into a prominent complex organ of the reproductive system. The genital atrium opens to the exterior as the genital pore near the median line on the ventral surface below the anterior end of the pharynx (Fig. 11).

There is a small organ between the ovary and testis which is filled with sperm cells and is apparently a seminal receptacle. No connections could be observed to show its relationship to the genital complex. The yolk glands are composed of follicles of cells which are distributed around the digestive tract throughout its entire length. Each is made up of a number of large granular cells displaying prominent nuclei. Connections between the individual vitellaria could not be made out. A small yolk reservoir is situated ventral to the ovary.

The eggs of this worm are very large for the size of the organism (Fig. 12). Numerous eggs were found adhering to the brood pouches and over the bodies of the hosts, *Trebius caudatus*, upon which the worms were found. The eggs ranged in size from 0.18 to 0.19 mm. in length by 0.09 mm. in width. They are brown-shelled and have a polar filament about 0.08 mm. in length.

No attempt was made to study the nervous system of this worm. The material was of such a nature that studies on the excretory system could not be satisfactorily undertaken. However, a pair of excretory vesicles appear as prominent structures on either side in the region of the posterior end of the pharynx.

Discussion

Without question the trematode under consideration belongs to the family Udonellidae. There is some question, however, in regard to its generic position. In most respects it is in perfect agreement with *Calinella* Monticelli (1910). The material upon which this study is based was somewhat distorted at the time of preservation and therefore some points could not be definitely determined. As far as external characters, the digestive tract, testis and ovary are concerned, there can be no question in regard to its generic relationship. There is some doubt, however, in regard to the nature and distribution of the vitellaria and the genital complex. The vitellaria form a band around the intestinal tract but are not as compact as shown by Monticelli. In this instance the vitellaria are grouped, more or less, into dense follicles which make up the band. The arrangement and distribution of the yolk glands is similar to that of *Udonella sciaenae* as indicated by Van Beneden and Hesse

(1863, 95). Further detailed study upon freshly prepared material is necessary to determine this point definitely.

The presence of an organ resembling a seminal receptacle situated between the ovary and testis also presents another difficulty. Monticelli does not refer to such an organ for *Calinella,* in fact, a seminal receptacle is not mentioned for any of the members of the family Udonellidae by any of the writers on this group. Whether or not, the structure observed in this instance is an artifact is open to question. It is not visible in whole mounts and can be observed only in sections. This point can only be cleared up through further study on suitably prepared material.

One other point of difference occurs in connection with the prostate gland. Monticelli (1910), in his generic description for *Calinella,* does not include this organ. His figures of *C. craneola* show a longer uterine tube and a longer vas deferens with the prostate gland to be lacking. He shows a large shell gland to be present.

A search of the available literature shows that *Calinella* has not been reported from North America. It also seems to show that there are very few, if any, records of members of the family Udonellidae from this country. In view of the above facts it is doubtful whether the present form should be included with the genus *Calinella.* There are many points in common but there are also differences. On account of the limited material for observation in the present study, it is deemed wise to designate this form provisionally as belonging to the genus *Calinella.* It is hoped that later studies on more abundant material will definitely determine its generic position. The specific name proposed for this worm is *myliobati,* the generic name of the host fish from which it was collected.

Genus and species: *Calinella myliobati,* sp. nov.

Host: The copepod, *Trebius caudatus,* parasitic on *Myliobatus californicus.*

Locality: Monterey Bay, California.

Summary

1. Ectoparasitic trematodes representing the two families, Tristomidae Taschenberg (1879) and Udonellidae Van Beneden and Hesse (1863), taken from the sting ray, *Myliobatus californicus,* are reported.

2. *Epibdella pacifica,* sp. nov. is described. These were taken from the buccal cavity of the sting ray.

3. A worm belonging to the family Udonellidae is recorded. It is described and is provisionally designated as *Calinella myliobati,* sp. nov. It is parasitic on the copepod, *Trebius caudatus,* which inhabits the body surfaces of *Myliobatus californicus.*

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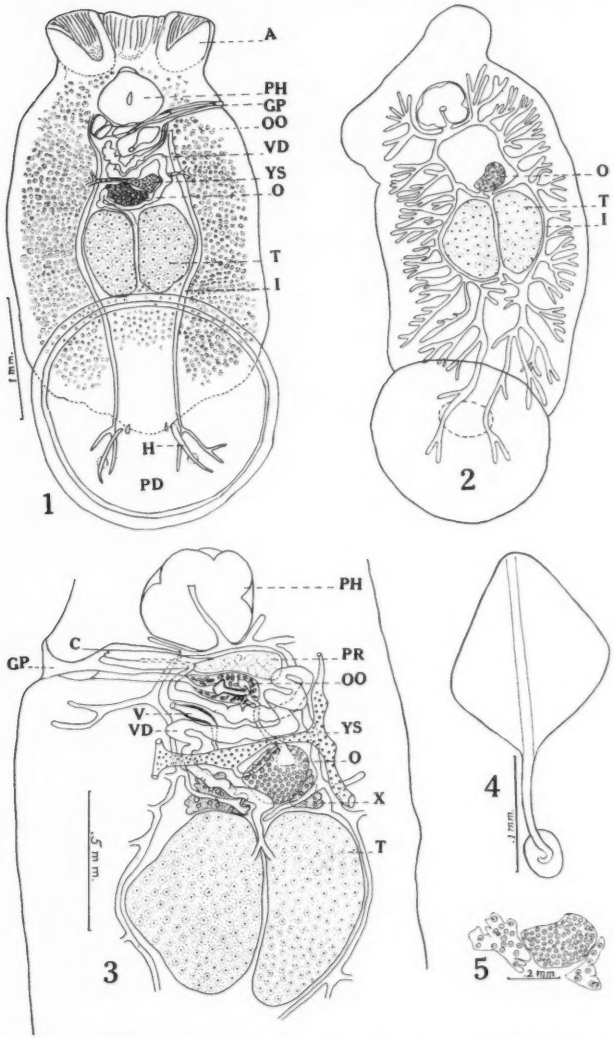
EXPLANATION OF PLATES

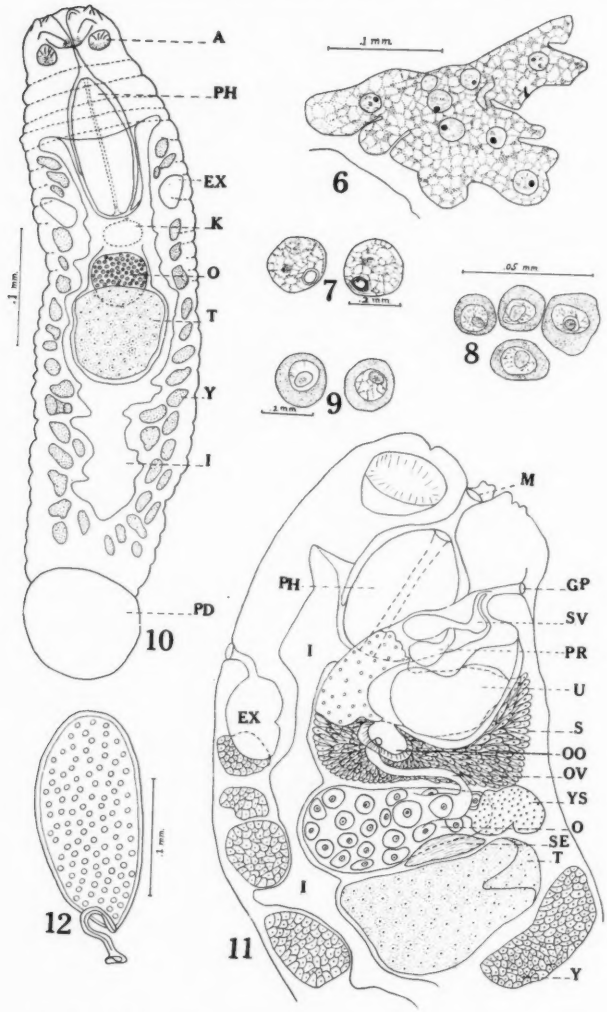
ABBREVIATIONS

A—Anterior sucker	PH—Pharynx
C—Cirrus	PR—Prostate gland
EX—Excretory vesicle	S—Shell gland
GP—Genital pore	SE—Seminal receptacle
H—Hook	T—Testis
I—Intestine	U—Uterus
K—Genital complex	V—Vagina
O—Ovary	VD—Vas deferens
OO—Ootype	Y—Yolk gland
OV—Oviduct	YS—Yolk sac
PD—Posterior disc	X—Problematic organs.

All drawings were made with the aid of a camera lucida.



Figs. 1-5. *Epibdella pacifica*—1. whole mount, ventral view.—2. Diagram of digestive tract, ventral view.—3. Reconstruction from dorsal view.—4. Egg.—5. Diagram of problematic organs and ovary.



Figs. 6-9, *Epibdella pacifica*.—6. Detail of problematic organ.—7. Nuclei of problematic organ.—8. Immature ova in ovary.—9. Mature ova from ovary.

Figs. 10-12, *Calinella myliobati*.—10. Whole mount.—11. Reconstruction, latero-ventral view.—12. Egg.

Studies of the Genus Scaphoideus (Homoptera-Cicadellidae)

Part I—Seventeen New North American Species

Dwight M. DeLong and Carl O. Mohr

Studies of the species of *Scaphoideus* occurring in North America have previously been made by Professor Herbert Osborn[1, 2] and Dr. E. D. Ball[3] both of whom have used wing venation and coloration as the principal bases for classification. Characters found in the external genitalia of both the male and female have been used to some degree in specific classification but these unfortunately are group characters for the most part and are specific only in a few cases. A detailed study of the internal male characters has shown these to be excellent specific characters and has also demonstrated that face color and in some cases rather definite color patterns or types of color patterns may represent two or more species which are quite different in genital characters. Certain color patterns seem to be quite specific.

The first North American species of this group described by Say[4] was named *Jassus immistus* and although the type has long since been destroyed, this name has been applied to and commonly accepted as the name of one of our common species. There is no mistaking the fact, however, that several species, because of similar color patterns and external characters, have been confused and placed under this name. As a starting point, therefore, in attempting to define the characters of the species of the genus it would seem fundamental to erect a neotype to represent this species and define it as a basis of comparison for the discussion and description of other species and for future studies.

Scaphoideus immistus (Say)

Jassus immistus Say, Acad. Nat. Sci. Phila. 6: 306, 1831.

A specimen has been chosen to fit the color description as given by Say.

Genitalia: Male plates about twice as long as wide, convexly rounded and somewhat narrowed but with broadly rounded spices. Styles slightly constricted near base, then convexly rounded to apical third which is abruptly narrowed to about one third its width, the apex curved strongly outwardly. Oedagus in ventral view with two long narrow parallel processes pointed at apices. In lateral view the oedagus in long and slender slightly curving ventrally and pointed at apex. A rather short dorsal process, bifurcate at

1 Jour. Cinc. Soc. Nat. Hist. 19: 187-209, 1900.
2 Ohio Naturalist 11: 249-261, 1911.
3 Jour. Wash. Acad. Sci. 22: 9-19, 1932.
4 Acad. Nat. Sci. Phila. 6: 306, 1831.

apex arises at about one third its length and extends dorsally and caudally. The bifurcate processes at apex are short, truncate and widely divergent.

Neotype male, Covington, Tennessee, June 18, 1915, (DeLong). In collection of senior author.

Scaphoideus dilatus sp. nov.

Resembling *immistus* in form and general appearance but darker in color and with distinct genitalia. Length 5.5-6 mm.

Vertex bluntly, broadly angled, as long on middle as basal width between eyes.

Color: Face pale brown with one complete line below margin of vertex. Vertex pale, transverse band orange red, rather broad. Pronotum dark brown, scutellum paler. Elytra brown, veins black, apices black. Two very small areolar spots on clavus and three or four in anteapical cells white.

Genitalia: Female last ventral segment strongly, roundedly produced and broadly margined with black. Male plates short and broad, shorter than combined basal width, convexly rounded to broadly rounded apices. Styles with long, narrow apical processes curved outwardly at apex. Oedagus in lateral view long, straight, gradually enlarged on apical third to apex which is sharp pointed and formed by the dorsal margin curving to straight ventral margin. Dorsal process arising at about one-third its length, extending caudally, apical end with two short divergent processes.

Described from a series of fourteen female and two male specimens from Hartstown Bog, Penna., collected Sept. 12, 13, 14, 1919, (DeLong); a female from Somerville, N. J., July 31, 1920 and two males, July 23, 1920, (Sanders); three males, North East Penna., August 2, and 19, 1919, (DeLong).

Holotype male (Hartstown Bog, Penna.), allotype female and male and female paratypes in senior author's collection. Male and female paratypes in Illinois State Natural History Survey Collection.

Scaphoideus crassus sp. nov.

Resembling *dilatus* in form but with different coloration and genitalia. Length 5-5.5 mm.

Vertex strongly produced, bluntly angled, almost as long at middle as basal width between eyes.

Color: Pale brownish with dark arcs on upper portion of face. Vertex white with slender marginal line, median transverse band almost straight, scarcely produced at middle and bright orange red in color. Pronotum brown with a broken, pale anterior band. Scutellum pale orange. Elytra brown marked with black and with very few pale areas. Inner clavus almost black with two small pale spots on apical half. Veins dark, apex broadly black.

Genitalia: Female last ventral segment strongly produced, black marked on apical portion and slightly notched at apex.

Male plates one third longer than combined basal width, narrowed to apices which are blunt and rounded. Styles narrowed so that apical third is

narrow and curved outwardly. Oedagus in lateral view long, rather broad, apex blunt, with a ventral pointed tip. At about one third its length it is decidedly enlarged and slightly narrowed beyond this point. The dorsal process arises at the point of enlargement, is rather slender, broadened and bifurcate at apex.

Described from a male and female specimen collected at Somerville, N. J., July 23, 1920 by J. G. Sanders, which are unique in color pattern and male genitalia. Holotype male and allotype female in collection of the senior author.

Scaphoideus curvatus sp. nov.

Resembling *dilatus* in general form but with distinct genitalia. Length 5 mm.

Vertex blunt at apex, almost as long at middle as basal width between eyes.

Face dark brown with pale arcs above. Vertex yellow, with conspicuous marginal line, median transverse band between eyes dark reddish brown rather broad and produced at middle. Pronotum dark brown with a pale transverse band. Scutellum, apical half pale yellow. Elytra brown, veins dark brown with very pale areas. Two very small ones near center of clavus along commissural line.

Genitalia: Female last ventral segment produced, rounded at apex and black margined.

Male plates slightly longer than combined width at base, apices broadly rounded. Styles with slender, outwardly curved apical third. Oedagus in lateral view narrowed at about half its length, produced, ventrally curved at apex with tip pointed. Dorsal process arising from enlarged portion broadened apically and bifurcate.

Described from two male and one female specimens collected at New Haven, Illinois, June 23, 1936 by Ross and DeLong.

Holotype male, allotype female and paratype male in Illinois State Natural History Survey collection, Urbana, Illinois.

Scaphoideus camurus sp. nov.

Resembling *immistus* in form, color, and general appearance but with distinct genitalia. Length 5.5-6 mm.

Vertex strongly produced, bluntly angled, as long at middle as basal width between eyes.

Color: Face yellow, at least two complete dark lines below margin of vertex. Vertex white, a rather narrow tawny band between eyes, slightly produced at middle. Pronotum dark with a pale transverse band behind eyes. Elytra pale brown, veins darker, intensity of dark markings variable, usually with dark markings at least on apical portion.

Genitalia: Female last ventral segment slightly roundedly produced and black margined. Male plates comparatively narrow at base, a little longer

than combined basal width, convexly roundingly narrowed to rather narrow, rounded apices. Styles gradually narrowed from base to form long, pointed apices which are tapered and curve outwardly at apex. Oedagus in lateral view long, almost straight, tapered toward apex where it is bent sharply ventrally and pointed. Dorsal process long and slender enlarged at apex, anterior process at apex very small, almost wanting.

Described from a series of three female and one male specimens collected at Port Royal, Pa., July 24, 1918 by J. G. Sanders, and one male, Karnak, Illinois, June 14, 1934, Ross and DeLong. Holotype male, allotype female and female paratypes in collection of the senior author. Male paratype in collection of Illinois State Natural History Survey.

Scaphoideus flexus sp. nov.

Resembling *immistus* in form and general appearance but with distinct male genitalia. Length 5-5.5 mm.

Vertex broad, bluntly angled, about one-fourth wider between eyes than length at middle.

Color: Face tawny with dark arcs on upper portion. A narrow dark line just beneath margin of vertex below which is a white band. Vertex with a slender dark line above margin not reaching eyes. Vertex white with a rather broad tawny band between the eyes scarcely produced anteriorly. Pronotum tawny with paler band on disc. Elytra brownish marked with darker brown and with veins darker.

Genitalia: Female last ventral segment slightly convexly narrowed to rather prominent angles between which the posterior margin is concavely, roundedly produced either side of a central produced lobe which is black margined. Male plates about one-fourth wider than combined basal width, straight on inner margin, convexly roundedly narrowed on outer margins to form blunt, rounded apices which are about half the basal width. Styles broad at base and constricted on outer margin, then gradually tapering to narrow rounded apices which bear a pointed tooth on outer margin. Oedagus in lateral view long, directed caudally, apical half gradually bending ventrally, apex enlarged, truncate with a ventrally pointed tooth on ventral margin. Dorsal process arising at about half its length, bifurcate at apex and concavely rounded between bifurcate tips.

Described from a series of five female and one male specimens, Hummelstown, Penna., June 28, July 6, 1919 and Sept. 8, 1920, (Knull); one male, Enterline, Penna., July 15, 1921, Guyton; 2 males, Tullahoma, Tenn., August 2, 1915, (DeLong); one male, Clarksville, Tenn. July 30, 1917, (DeLong); one male, Ashley, Illinois, August 7, 1917; one male, Jonesboro, Ill., July 31, 1930, (Mohr & DeLong); one female, Marshall, Ill., Sept. 27, 1934, (Frison & Ross); two females, Elizabethtown, Ill., June 27, 1927, (at light); one female, Shawneetown, Ill., June 21, 1927, (at light); one male and one female, Du Bois, Ill., August 9, 1917; one male, White Heath, Ill., June 29, 1917; one male, Dolson, Ill., July 24, 1936, (Mohr & DeLong).

Holotype male, allotype female (Hummelstown, Pa.) and male and female paratypes in senior author's collection. Male and female paratypes in Illinois State Natural History Survey Collection.

Scaphoideus radix sp. nov.

Resembling *immistus* in form and general appearance but darker in color and with distinct genitalia. Length 4.5-5 mm.

Vertex broadly bluntly rounded, one-fifth wider between eyes than median length.

Color: Face pale, dusky either side next eyes and with dusky arcs above. A fine sinuate dark line on margin of vertex, a conspicuous pale band beneath. Another fine dark line just above ocelli almost touching marginal line at center. Vertex pale with a narrow, conspicuous brown band between anterior margins of eyes, which is slightly produced at middle and is bordered with reddish brown on its posterior margin. Pronotum dark brown, black behind either eye, a white cross band on anterior portion of disc. Scutellum dusky anteriorly, posterior half pale, a black dash either side of apical angle. Elytra pale, mottled with brown, veins brown. A large brown spot at apex of first claval vein and a large one on the disc.

Genitalia: Female last ventral segment with posterior margin slightly concave either side of a central broad produced lobe which is blunt at apex and slightly bifid. Male plates about as long as combined basal width, only slightly narrowed to apices which are broadly rounded. Styles abruptly narrowed at about two-thirds their length to form long slender processes on the inner margin which curve outwardly. Oedagus in lateral view long, slender on apical half to near apex which is enlarged into a foot-shaped structure with the heel on the dorsal margin and the long pointed toe extending ventrally. A long slender bifurcate dorsal process arises about one-third the distance from base and extends dorsally and caudally.

Described from a male and two female specimens collected in an open woodland at Wilmington, Illinois, August 20, 1935 by H. H. Ross and the senior author. Male holotype and female allotype in Illinois Natural History Survey collection. Female paratype in collection of the senior author.

Scaphoideus pullus sp. nov.

Resembling *melanotus* and previously confused with it but differing by having face paler, clavus darker with smaller pale spots and with different genitalia. Length 4.5-5.5 mm.

Vertex bluntly angled, one fourth wider between eyes than median length.

Color: Face pale brown with arcs always conspicuous above. Cheeks and lorae much darker brown or black. Vertex pale yellow, with a narrow black marginal line and a narrow median reddish band, usually straight, between eyes. Pronotum paler at middle, darker either side, scutellum yellow, basal angles dark brown. Elytra pale brown heavily infuscated, inner clavus appearing to have a much darker stripe along inner margin with two paler spots on posterior half. Very few pale whitish areas.

Genitalia: Female last ventral segment produced and rounded, posterior two thirds black. Male plates shorter than combined width slightly narrowed to apex which is broadly rounded. Styles with apices narrowed, curved out-

wardly and sharply pointed. Oedagus in lateral view enlarged on apical fourth curved ventrally near apex and with ventral bluntly pointed apex.

Described from four male and three female specimens, Hummelstown, Penna., June 28, and July 6, 1919, (Knull); one female each at Waynesburg, Penna., July 17, 1919, (DeLong); Hartstown Bog, Penna., Sept. 4, 1919, (DeLong); Cameron, Wis., August 7, 1916, (DeLong); Madison, Wis., July 9, 1916, (DeLong); one male Landisburg, Pa., June 30, 1919, (Sanders); one male, Washington, D. C., July 3, 1919, (Sanders); one female each from St. Joseph, Illinois, June 27, 1915; Karnak, Illinois, June 14, 1934, (Ross and DeLong); Metropolis, Illinois, August 20, 1916; Dubois, Illinois, August 9, 1917; Hicks Branch, Eichorn, Illinoir, June 24, 1932, (Ross, Dozier, and Park).

Holotype male (Washington, D.C.), allotype female (Hummelstown, Penna.) and male and female paratypes in author's collection. Female paratypes in Illinois State Natural History Survey Collection, Urbana, Illinois.

Scaphoideus auctus sp. nov.

Resembling *obtusus* in genital structures but with a darker distinct color pattern. Length 5 mm.

Vertex bluntly angled, one-fourth wider between eyes than length at middle.

Color: Face yellowish, one complete dark line below margin of vertex, and several arcs. Vertex pale with transverse band orange in color, marginal band on anterior portion of pronotum and scutellum pale. Elytra gray, heavily marked with dark brown or black, veins very dark.

Genitalia: Female last ventral segment rather strongly, roundedly produced, apex faintly notched. Male plates a little longer than combined basal width, broadly rounded at apex. Apical third of styles long, slender, tapering to attenuated, outwardly curved apices. Oedagus in lateral view long, rather broad, enlarged at apex and obliquely sloping to form a caudally, ventrally directed bluntly pointed apex. Dorsal process rather short and broad, concave at apex forming two short thick divergent processes.

Described from a series of four female and two male specimens collected at Waynesburg, Pa., July 17, 1919, (DeLong); two males, Hummelstown, Penna., June 22, 1919, (Knull); one male, Madison, Wis., July 9, 1916, (DeLong); seven males, Urbana, Illinois, two on July 5, 1915, one on July 4, 1916, two on July 27-30, 1917, one on June 20, 1915, one on June 30, 1916, one on July 4, 1916; and two females on July 18, and August 28, 1917; one male and two females, Kankakee, Illinois, July 20, 1934, (Ross and DeLong); one male and one female, Grafton, Illinois, June 26, 1934, (Ross and DeLong); one male each from Vienna, Illinois, June 14, 1934, (Ross and DeLong); Herod, Illinois, June 20, 1935, (Ross and DeLong); Apple River Canyon, Illinois, July 11, 1934, (Ross and DeLong); Kampsville, Ill., June 27, 1934, (Ross and DeLong); Volo, Illinois, July 27, 1934, (Ross and DeLong); one female, Rock Island, Illinois, July 7, 1934, (Ross and DeLong).

Holotype male (Waynesburg, Penna.) allotype female ,same) and male aand female paratypes in author's collection. Male and female paratypes in Illinois Natural History Survey Collection, Urbana, Illinois.

Scaphoideus baculus sp. nov.

Resembling *luteolus* in general appearance and coloration, but paler, more tawny, and with distinct genitalia. Length 4.5-5 mm.

Vertex convexly rounded, broadly bluntly angled, a little wider between eyes than length at middle.

Color: Face tawny, margin of vertex white with two conspicuous black lines below, and a marginal line above extending between ocelli. Almost entire vertex covered with a broad, tawny band, leaving only a pale anterior narrow portion anterior to ocelli and a broad v-shaped median portion behind. Pronotum usually darker with traces of a white cross band just back of eyes. Scutellum tawny, apical third white or paler than basal portion. Elytra tawny veins brown, almost devoid of areolar spots. Brown spots at apex of first claval vein, at apex of clavus and apex of elytra.

Genitalia: Female last ventral segment slightly narrow caudally to form rather prominent angles between which the posterior margin is concavely roundedly produced to form a pair of prominent black teeth separated by a V-shaped notch. Central apical portion of segment black. Male plates about as long as combined basal wiidth convexly rounded to bluntly angled apices. Oedagus in lateral view extending caudally, straight and slender, three-fourths its length where it is abruptly bent so the apical portion extends ventrally. The apical fourth is sometimes about uniform in width and rounded at the apex and sometimes tapered to a pointed apex and with a small dorsal spur at the point where it bends.

Described from a series of 16 male and 14 female specimens. Two males are from Harrisburg, Pa. collected July 7, 1918 by J. G. Sanders. One male was collected at Columbus, Ohio, July 28, 1928. One male was collected at each of the following: Alton, Ill., July 19, 1932, (Ross and Dozier); Dolson, Ill., July 24, 1936, (Mohr & DeLong); Urbana, Ill., July 17, 1934, (DeLong); Urbana, Ill., Aug. 2, 1916 and Sept. 28, 1915. Seven males and six females were taken at Urbana, Ill. Aug. 28, 1917, and one male and female on July 23, 1917. One female was collected on each of the following dates: Dubois, Ill., July 9, 1909; Urbana, Ill., Aug. 9, 1910, (Malloch); Aug. 30, 1914, Aug. 4, 6, 8, 1916 and Sept. 3 and 6, 1916.

Holotype male, Harrisburg, Pa. and male and female paratypes in senior author's collection. Allotype female, Urbana, Ill., Aug. 30, 1914, and male and female paratypes in Illinois Naturala History Survey collection, Urbana.

Scaphoideus brevidens sp. nov.

Resembling *immistus* in form and general appearance but with gentialia resembling *opalinus*. Length 5-5.5 mm.

Vertex convexly rounded, broadly, bluntly angled, about one-fifth wider between eyes at base than length at middle.

Color: Face pale with a series of dark arcs above. Margin of vertex white with a narrow line just above and one just below. The transverse band between eyes on vertex narrow, produced at middle and pale brownish. Pronotum brownish, scutellum paler on apical half. Elytra pale, veins darker, often almost black especially at apex.

Genitalia: Female last ventral segment with posterior margin convexly rounded and slightly notched at apex. Male plates one-third longer than combined basal width, convexly rounded to rather broad, rounded apices. Styles long, basal two-thirds rather broad then convexly roundedly narrowed

to form long, slender outwardly curved processes on inner margin. Oedagus in lateral view with a long slender ventral process which is bifid on apical third which processes are not as long as the dorsal portion of oedagus. Dorsal process arising at about two-thirds its length and extending dorsally, narrow at base, broadened to apex which is concavely rounded between a small anterior tooth-like projection and a posterior finger-shaped process which curves dorsally and anteriorly.

Described from four female and three male specimens collected at Clarksville, Tennessee during July and August 1915, DeLong; a male and two females from Paris, Tenn., June 16, 1915; a male and female from Moscow, Tenn. June 25, 1915, (DeLong); one female from each of the following: Medina, Wisconsin, Aug. 23, 1916, (DeLong); Bells, Tenn., June 16, 1915, (DeLong); Amery, Wis., Aug. 13, 1916, (DeLong); Marshfield, Wis., Aug. 20, 1916, (DeLong); Castalia, Ohio, Aug. 8, 1914, (DeLong); Columbus, Ohio, Oct. 16, 1921, (DeLong); Bellaire, Ohio, Aug. 24, 1914; Brookings, S. D., Aug. 20, 1921, (Severin); two females, Louisiana, 1910; two males, Camp Douglas, Wis., Aug. 1, 1916, (DeLong); one male each Knoxville, Tenn., Sept. 14, 1915, (DeLong); Merrilan, Wis., Aug. 5, 1916, (DeLong); Bridgeport, Ohio, Aug. 30, 1915; seven females and six males, Hartstown, Penna., Aug. 12 and 13, 1919, (DeLong); four males and three females, Waynesburg, Penna., July 16, 1919, (DeLong); five females, State College, Penna., July 25, 1917, (Sanders); five males, Port Trevoiton, Penna., July 26, 1919, (Sanders); four males and 18 females North East, Penna., July and Aug., 1919, (DeLong); twenty four females and three males, Alton, Illinois, June 27, 1934, (Ross and DeLong); one male and five females, Dolson, Illinois, July 18, 1934, (Ross & DeLong); two males from Zion, Illinois, July 25, 1934, (Frison & DeLong); two males, Palos Park, Illinois, Aug. 21, 1934, (DeLong and Ross); one male and five females, Volo, Illinois, July 27, 1934, (Ross & DeLong).

Holotype male (Clarksville, Tenn.) allotype female (same) and male and female paratypes in senior author's collection. Male and female paratypes in Illinois State Natural History Survey Collection, Urbana, Illinois.

Scaphoideus diutius sp. nov.

Resembling *immistus* in form and general appearance but with blunt vertex and distinct genitalia. Length 5 mm.

Vertex bluntly and rather broadly angled, basal width between eyes a little greater than median length.

Color: Face yellow, at least one complete dark line below margin of vertex. Vertex pale, a rather broad tawny band between eyes scarcely produced at middle. Pronotum with a rather faint transverse band back of eyes. Elytra pale tinged with brown, veins dark brown.

Genitalia: Female last ventral segment with posterior margin roundedly produced and broadly black margined. Male plates longer than combined basal width, scarcely narrowed to apices which are broadly rounded. Styles abruptly narrowed and produced on apical third as narrow processes which curve slightly outwardly. Oedagus in lateral view similar to *brevidens* but with the apical ventral processes longer than dorsal process, and the dorsal process with a more slender curved finger process on posterior margin than in *brevidens*.

Described from four male specimens collected at Tobyhanna, Pa., Aug. 14,

1920 by J. G. Sanders, and two males and one female collected at Starved Rock, Illinois, July 14, 1932 by Dozier and Park. Holotype male, Tobyhanna, Pa., and male paratypes in collection of senior author. Allotype female, Starved Rock, Ill., and paratype males same place and date in State Natural History Survey Collection, Urbana, Illinois.

Scaphoideus nigrellus sp. nov.

Resembling *sensibilis* in coloration but smaller and with genitalia more closely related to *opalinus*. Length 4.5-5 mm.

Vertex strongly produced and bluntly angled, a little longer on middle than basal width between eyes.

Color: Beneath black, face black with three pale arcs below vertex. Black of face extending up over margin of vertex. Vertex white with a broad black band between eyes strongly produced anteriorly at middle and shading to brown posteriorly. Pronotum black with an interrupted white transverse band behind eyes. Elytra brownish, heavily marked with black, varying in intensity but with a few white *areolar* spots. The two on clavus along commissural line usually conspicuous.

Genitalia: Female last ventral segment roundedly produced and with a large black area on median apical portion. Male plates broad and slightly narrowed to broadly rounded apices. Oedagus in lateral view with a long slender basal portion extending almost caudally with a bulb-like portion arising at about half its length extending dorsally and caudally. The apical end is broad and concavely excavated, the outer margins with projecting points. The apical portion of lower oedagus bifid.

Described from a series of seven females and five male specimens collected at Dolson (Rocky Branch) Illinois, July 18, 1934 by Ross and DeLong, and 59 female and 16 male specimens from the same locality on July 24, 1936 by Mohr and DeLong. Three females and one male, Urbana, Illinois, September 10, 1934, (H. H. Ross); one male, Wilmington, Ill., Aug. 20, 1934, (Ross and DeLong); and three females, Danville, Ill., Aug. 17, 1934, (Ross and DeLong). These occur on the *Solidago* herbaceous habitat of the flood plain woods.

Holotype male and allotype female, Dolson, Illinois, July 18, 1934 and male and female paratypes in the collection of Illinois Natural History Survey, Urbana, Illinois. Male and female paratypes in collection of senior author.

Scaphoideus amplus sp. nov.

Form and general appearance of *dilatus* but with distinct genitalia. Length 5.5 mm.

Vertex broadly, bluntly angled, a little wider between eyes than length at middle.

Color: Face pale brown, dark line above sometimes faint in color. Vertex yellowish, transverse band on disc of vertex narrow and sometimes faintly marked with fuscous. Elytra dull or pale brownish with few white areolar spots, veins dark brown.

Genitalia: Female last ventral segment slightly roundedly produced. Male

plates longer than combined basal width, sides convexly rounded to broadly rounded apices. Styles with apical third long, slender, extending caudally, apex slightly turned outwardly. Oedagus in lateral view resembling *brevidens* but with dorsal process triangular with the caudal finger-like structure produced, but the projection on the anterior margin lacking.

Described from a series of five females and three males collected at Hartstown Bog, Pa., August 12, 13 and 14, 1919, D. M. DeLong; one male Port Trevoiton, Pa., July 26, 1918, J. G. Sanders; and one female Presque, Id., Pa., Aug. 29, 1919, D. M. DeLong. Holotype male and allotype female Hartstown Bog, August 13, 1919 and male and female paratypes in collection of senior author.

Scaphoideus scelestus sp. nov.

Resembling *melanotus* in color pattern but with genitalia resembling *opalinus*. Length 5-6 mm.

Vertex bluntly and broadly angled, a little wider between eyes at base than median length.

Color: Superficially resembling melanotus in color. Face pale, with two complete dark lines and broken arcs on upper portion. Vertex, pronotum and scutellum usually pale in color, transverse band between eyes narrow and paler than normally. Elytra heavily infuscated with dark brown or black, anterior half appearing solid black without areoles. Two areoles on middle of clavus, and a few in anteapical cells milky white.

Genitalia: Female last ventral segment roundedly produced and black margined. Male plates short and broad, only slightly longer than combined basal width, scarcely narrowed toward apices which are broadly rounded. Styles abruptly narrowed at a little more than half their length, apices long, slender, directed caudally and curved outwardly at apex. Oedagus in lateral view similar to *brevidens*, basal portion slender, straight, dorsal process arising near apex, pointed at base broadened toward apex which bears a long curved finger-like process on caudal apical extremity which is curved dorsally.

Described from a series of one female and six male specimens collected at Waynesburg, Pa., July 16 and 17, 1919, D. M. DeLong; one male Port Royal, Pa., July 24, 1918, J. G. Sanders; one male Harrisburg, Pa., July 7, 1918, J. G. Sanders; and one male Marietta, Pa., July 12, 1919, T. L. Guyton. Holotype male, allotype female (Waynesburg, Pa.) and male paratypes in senior author's collection. Male paratype in State Natural History Survey Collection, Urbana, Illinois.

Scaphoideus bifurcatus sp. nov.

Resembling *angustus* in size and general appearance but with distinct and unique genital structures. Length 5.5-6 mm.

Vertex strongly produced and rather sharply angled, a little wider between eyes than length at middle.

Color: Face pale with two heavy lines above. Vertex pale in color, transverse band pale tawny, rather indistinct. Pronotum and scutellum pale tawny.

Elytra white tinged with brown, veins dark brown especially on posterior half. Apex dark brown.

Genitalia: Female last ventral segment with posterior margin roundedly produced, a small black spot on middle of posterior margin. Male plates a little longer than combined basal width concavely narrowed on apical half to form pointed apices. Apical third of styles long, narrow, and curved. Oedagus with a pair of processes arising near base, which are divergent to near apices where they are abruptly bent inwardly and cross just before their apices. A long slender median process arises at the base of the dorsal process and lies ventrally between the two arms of the oedagus extending almost to the point of their intersection where it bears a pair of laterally divergent processes.

Described from two male and one female specimens taken at Ohio Pyle, Pa. One male collected July 20, and a male and female on July 19, 1919, D. M. DeLong; a male from Port Royal, Pa., July 24, 1918, J. G. Sanders; and two males from Drumgold, Pa., one July 16, 1920, T. L. Guyton, and one July 12, 1918, J. G. Sanders. Holotype male, Ohio Pyle, July 20, 1919; allotype female and male and female paratypes in collection of senior author.

Although this species cannot easily be distinguished from others by external characters it is unique in regard to internal structures.

Scaphoideus frisoni sp. nov.

Resembling *carinatus* in general appearance but smaller and with distinct genitalia. Length 6 mm.

Vertex strongly produced, apex blunt, length at middle equalling basal width between eyes.

Color: Face brownish, darker next eyes with a series of broken arcs and two broad black bands beneath margin of vertex. Vertex white, marginal line above interrupted at middle and widened either side at apex. Transverse band with central portion produced and ends sloping anteriorly. Scutellum pale, basal angles darker. Elytra white, mottled with brown. Veins and apex dark brown.

Genitalia: Female last ventral segment broadly roundedly produced and slightly keeled at middle. A black spot on apex of margin. Male plates about as long as combined basal width, convexly rounded on basal portion, concavely rounded to form blunt, pointed apices. Apical half of styles are long, narrow attenuated processes curved at base and directed caudally. Oedagus in ventral view with a pair of long processes arising near base which are separated near base, almost contiguous near middle then are again separated and cross each other so that the apical fourth is directed laterally and is slender and tapered at apex. Dorsal process with a longer, more slender apical portion than in *veterator*. A broad but prominent tooth on apex of pygofer. This will easily and readily distinguish it from closely allied species.

We take pleasure in naming this species for Dr. T. H. Frison who has collected many interesting species of Cicadellidae in Illinois.

Described from a series of 13 female and one male specimens collected at Trout Lake, Wisconsin, Sept. 7, 1916, (DeLong); 2 females, Amery, Wis., Aug. 1916, (Sanders & DeLong); 2 females, Pembine, Wis., Sept. 4, 1916, (DeLong); one female, Marshfield, Wis., Aug. 20, 1916, (DeLong); one female, Octonto Co., Wis., Sept. 20, 1912, (Sanders); eight female specimens, Trout Lake, Wisconsin, Aug. 12, 1936, (DeLong); one female, Cranberry Lake, N. Y., July 8, 1920, (Sims); five male and one female, Manada Gap, Penna., July 3, 1918, (Knull & Kirk); four females and one male, N. Bloomfield, Penna., July 16, 1920, (Sanders); one female, Port Matilda, Penna., Aug. 24, 1918, (Sanders); a male and female, Ocean City, Md., June 18, 1918, (Sanders); five female specimens, Penfield, Penna., Aug. 24, 1918, (Sanders); and a male and female, Orono, Maine, July 31, 1913 and Aug. 15, 1913, (Osborn).

Holotype male and allotype female (Manada Gap, Penna.) and male and female paratypes in senior author's collection. Male and female paratype in Osborn collection. Female paratypes in Illinois State Natural History Survey collection.

Osbornellus borealis sp. nov.

Resembling *scalaris* in coloration and general appearance but smaller and with distinct genitalia. Length 5 mm.

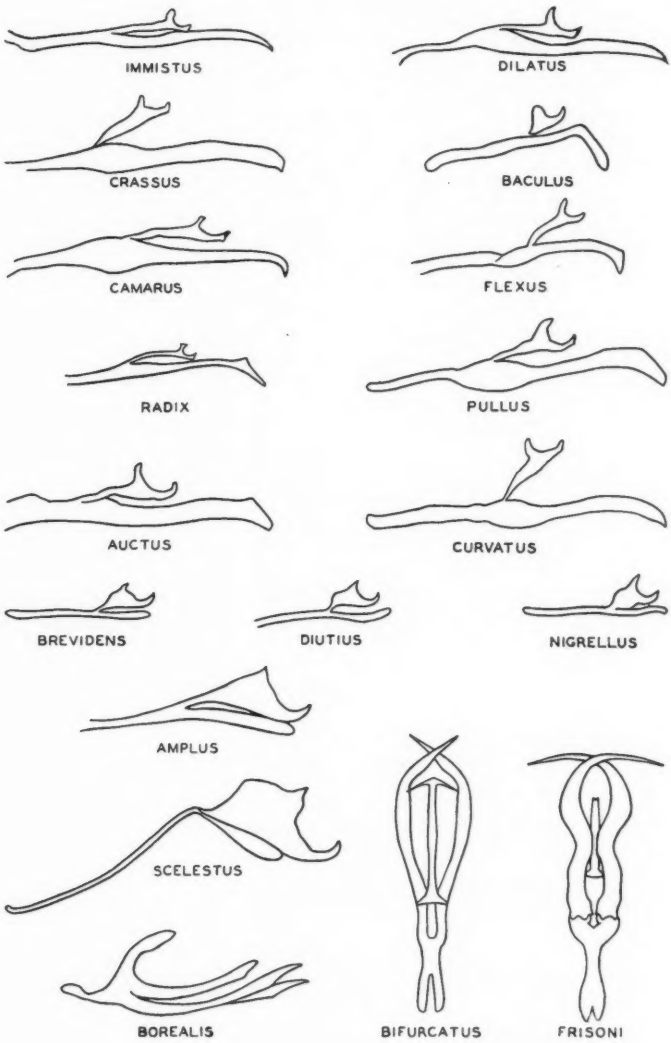
Vertex rather sharply angled, as long at middle as basal width between eyes.

Color: Similar to *scalaris* but without reddish spot above apex. Vertex pale, the waved brown line just back of apex and a rather distinct band curving forward at center, extending between ocelli, brown. Pronotum and scutellum brown, finely mottled with yellowish. Elytra white, veins brown. Inner ends of claval veins, apex of clavus, costal anteapical veinlets, broadly brown. Central area of cells on disc and of second and third anteapical cells brown.

Genitalia: Male plates long, tapering to attenuated apices. Styles broad at base gradually narrowed to apical half which is very slender and directed caudally. Oedagus in ventral view with paired ventral arms overlapping just before apices. In lateral view it is broad and curved near base with a dorsal spur extending dorsally and three processes, a dorsal and two ventral, arising from ventral arm of curvature, which are long and extend caudally.

Described from a single male specimen from Cranbrook, B. C., Sept. 4, 1919. Holotype male in author's collection.

Illinois State Natural History Survey,
Urbana, Illinois.



Lateral views of oedagi of male genitalia of species of Scaphoideus as named except in cases of *bifurcatus* and *frisoni* where the ventral view is illustrated.

Size of Shell in Land Snails of the Genus Polygyra

With Particular Reference to Major and Minor Varieties *

Thural Dale Foster †

Variations in size of animals of the same age are of particular interest to the student of biological problems. The adult land snails of the genus Polygyra concerned in the study of variations may be considered as one unit, since growth of the shell stops on the formation of the lip. This does not mean that all growth ceases with the formation of the lip. There is little doubt that there is an increase in weight of the individual during the period just after the formation of the lip and in advanced maturity. The shell becomes thicker and this obviously adds to the weight of the older adults.

Most of the land snails common in Illinois, and particularly the Polygras that are so abundant in flood plain areas, are widely distributed throughout the eastern half of the United States and Southern Canada. It is natural to expect great variation in size in the different species when one considers the enormous extent of territory which the snails inhabit and the diverse environmental factors which they encounter. This variation raises the question whether the variation is racial in character or only individual among species in a given area.

Polygyra thyroides is very common in the greater portion of Illinois, particular in those areas that include the valleys of a river system. Variation in size (Fig. 1) is very common in the same area. Extremes of size have been thought by various students to merit varietal distinction. In 1892, T. D. A. Cockerell described some specimens of *P. thyroides* taken at Toronto, Canada, as a variety, the emphasis being placed on size as the name "*pulchella*" implies. The smaller southern form which occurs in the same habitat with the typical form was designated as a variety by Gould under the name *bucculenta*. H. A. Pilsbry (1897), in "A Classified Catalogue of American Land Shells, with Localities," lists the locality of this form as Louisiana and Texas, but in a note questions the validity of the varietal name. There are numerous reports in the literature on the variation in size of other species of Polygyra as well as *P. thyroides*, and the terms "major" and "minor" are used to designate two supposedly distinct racial groups.

A monthly quantitative study of *P. thyroides*, in which each individual of every collection was measured, showed great diversity of size (Fig. 1). It was thought at first that the variation was the result of faulty collecting in the field, as it would be possible in collecting in the flood plain near its junction with the upland to obtain some upland variants which represented a "minor" group. W. S. Strode (1895), in "Helices in Illinois," reports the

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† Mr. Foster died on June 6, 1936. This manuscript, which is a section of his doctoral dissertation, has been edited by H. J. Van Cleave under whose direction the thesis was prepared.

results of an observation on the distribution of *Polygyra multineata* in the Spoon River Valley. Although he records no measurements, he states that a large variety occurred on the bottoms and a small variety on the hillsides adjacent. However, as the present study of *Polygyra thyroides* continued it was found that the "small" occurred with the "large" regardless of the site on the flood plain where samples were taken.

As *P. thyroides* is not the sole representative of the genus on the flood plain of the Sangamon River where this study was carried on, an attempt was made to explain the variation by intergradation with *P. pennsylvanica,* a closely associated species. The smallest forms of the *P. thyroides* in the collections were of approximately the same greater diameter as *P. pennsylvanica.* A study was made of all the small forms in the entire collection of *P. thyroides,* both with the living specimens and dead shell material, and in all cases it was found that the small forms remained typical in form, whorl count, color, etc. There were only two specimens of *P. thyroides* that had the closed umbilicus, characteristic of *P. pennsylvanica,* or that in any way resembled that species. Therefore, this theory was discarded as of no value in an attempt to explain the variation.

It was then thought that perhaps the smaller forms represented a racial group distinct from the large forms. Bryant Walker (1910), concludes that this species consists of two distinct racial groups in Michigan.

In the present study the writer used two sets of measurements on 845 dead adult shells (Fig. 2) collected at White Heath, Illinois. (1) The greater diameter, that is, the greatest width of the shell measured on a line at right angle to the axis and excluding the lip. (2) The lesser diameter, the width taken in front of the aperture on a line at right angle with the axis.

In interpreting the curves it is the opinion of the writer that the minor modes (Figs 2 and 3) impressed on the curves at approximately the midpoints between the largest and smallest size groups have no significance and the curves if smoothed would represent a typical distribution curve of variation within a single group. No evidence is presented to show that there are two distinct size groups, or major and minor varieties.

A similar investigation of variation was made of *Polygyra pennsylvanica,* from the same flood plain habitat, and of *Polygyra clausa* from a railroad embankment that passes through the flood plain. Although only 145 specimens of *pennsylvanica* were available for the study of variation it is clear that only one mode is impressed on the curve. Again in *P. clausa* the same results were obtained from a study of 111 shells.

On May 30, 1932, a collection of 246 adult individual shells of *Polygyra elevata* was taken from a steep hillside bluff of Stony Creek, near Muncie, Illinois, in Vermilion County. A study of variation, made as in the preceding species (Fig. 4) presents a unimodal curve in the distribution of size groups.

The material obtained by the Illinois Land Molluscan Survey in 1931 and 1932 was deposited in the Natural History Museum of the University of Illinois. Through the courtesy of the curator, Mr. Frank Collins Baker, this material was made available for the study of variation of *P. thyroides* in

Illinois. Although the object of the survey was primarily a study of distribution and taxonomic study of all the species of land snails, in a few instances the samples taken in a locality of the same kind of habitat contained enough specimens of *P. thyroides* to make a comparative study indicative even if not conclusive of variation in size for this species.

One hundred and twenty-five adult shells were obtained from Hancock County, Illinois, on the Mississippi River limestone bluff. In this sample the variation in size is almost identical with the White Heath collections in Piatt County, Illinois, and the unmodal nature of the curve is the same.

In Union County, Illinois, a greater variation is obtained in the sample than in either the Hancock County or Piatt County samples. There is a tendency for the mode to fall among the groups representing the largest individuals, but there is no evidence to show that it has a bimodal nature. Only 58 specimens were available for the study of the group in this locality and while the results show the general character of the *P. thyroides* population they are not taken by the writer as conclusive. Union County is in the extreme southern end of the state, south of the Okarkian uplift and its fauna closely resembles that of Tennessee and other southern states.

Washington County seems to offer the poorest environment for the attainment of the typical size for *P. thyroides*. However, the material from this county does not all come from the same type of habitat, but comes from orchards, flood plains, open woodlands, etc. Even if the numbers of individuals (90 specimens) were large enough to furnish conclusive evidence of the character of the snail population in the same habitat, the validity of the conclusion can still be doubted on the method of sampling. The result is included here only to show that environmental factors evidently do influence, to some extent, the size of *P. thyroides*, and is a record of the smallest individuals found in the state, having a greater diameter of only 15.4 mm.

The variation in proportion to size is greater for *P. thyroides* in Illinois than for *P. albolabris* in Michigan. The smallest individual of *P. thyroides* found in this study attains a greater diameter of approximately 54 per cent of the largest specimen, while in the study of *albolabris* made by Walker the percentage is approximately 57.

Allen F. Archer (1932) states, "It is now becoming increasingly apparent that size is not a good test for determining North American Polygyrae. The best example of that fact is *Polygyra thyroidus* (Say), which varies greatly in size in certain localities."

From a study of the data presented in the variation study of *Polygyra albolabris* in Michigan by Mr. Bryant Walker it is the opinion of the writer that his conclusions are founded on a study of samples that are not representative of a single locality in Michigan, with the possible exception of the Isle Royal series. Of the 511 specimens on which the study is based, 162 came from outside the state; of the 349 from Michigan, 225 specimens represent 53 separate lots taken from 38 of the 83 counties in the state; 9 specimens are from Traverse City, Michigan, part of an original lot of a smaller varietal form designated as *P. albolabris traversensis* by Leach, and the remaining 125 are from Isle Royal, Lake Superior, Michigan. The only lot that approaches a representative collection for a varietal study from a

given locality was not included by the author in the general Michigan series, i.e., the lot from Isle Royal. Conclusions based on numbers that are not representative are invalid or at least only doubtfully valid. It is not for the writer to state definitely just the exact number that would present a true picture of the population of a given locality, but in this study any collection numbering less than 100 specimens, while considered as indicative of a general condition, is not taken as conclusive.

Another variation study (Figs. 2 and 5) made on the 845 dead shells of *Polygyra thyroides* taken from White Heath, Illinois, was made to learn if there was any variation in the size of the dentate and non-dentate specimens obtained in the collection. Fig. 5 shows that there is no significant difference in the general trend of the curves. They tend to conform closely to the unimodal condition of the curves portraying variation in size irrespective of the presence or absence of the weak parietal tooth. F. A. Simpson (1914), in a discussion of eleven species of Helicides found in a post-Pliocene deposit at Providence, Missouri, designate the toothless form of Polygyra as "edentate," thus recognizing this form as a varietal group, and stating that 36 out of 50 were thus encountered. From the evidence shown by the White Heath samples, that is, of the 845 specimens observed, 429 were non-dentate and 418 dentate. It appears that a weak tooth may or may not be present in the typical form and cannot be considered as a valid taxonomic character.

From a careful study of the data obtained by an analysis of the distribution curves for variation in four species of Polygyra it seems that the following conclusions are justified:

(1) That Polygyra represented by the four species, *P. thyroides, P. pennsylvanica, P. clausa,* and *P. elevata,* shows great variability in size in Illinois.

(2) That the variation in the representative collection of Polygras from the same habitat is individual in character and not racial, or that "major" and "minor" varieties do not exist.

(3) That large and small individuals exist in the same locality irrespective of the nature of the habitat.

(4) That environmental factors undoubtedly influence the size of *P. thyroides* in Illinois, and if depauperization takes place it is individual, not racial, and does not merit recognition as such.

(5) That a weak parietal tooth may or may not be present in *Polygyra thyroides,* and if absent does not constitute a group worthy of a varietal designation.

(6) That variation in size is the same in the dentate as in the non-dentate form of *P. thyroides.*

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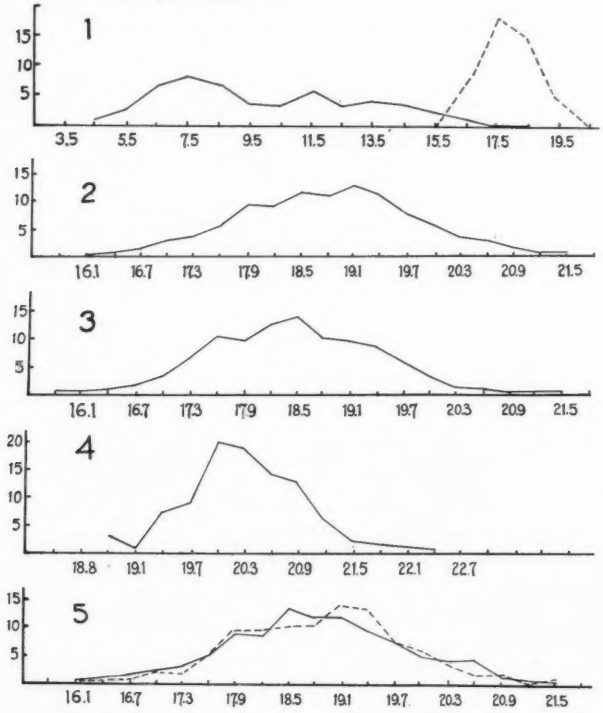


Figs. 1-5. Graphs showing variation in size of some Illinois land snails. In each graph, the ordinate represents percentage of individuals dispersed in size groups based on lesser diameter of the shell as indicated in mm. along the abscissa. Numeral indicating size is median for each increment; thus 16.7 in Fig. 2 includes all individuals having lesser diameter from 16.6 to 16.8 mm. inclusive.

Fig. 1. Size range of *Polygyra thyroides* in winter collections (Dec., Jan., and Feb.) based on 305 young individuals (solid line) and 424 lipped shells (broken line).

Fig. 2. Distribution of 845 unselected dead shells of *Polygyra thyroides* from Sangamon River flood plain at White Heath, Illinois.

Fig. 3. Distribution of 1158 unselected living adult shells from same locality as those shown in Fig. 2.

Fig. 4. Distribution of 246 living adult shells of *Polygyra elevata* from Muncie, Illinois.

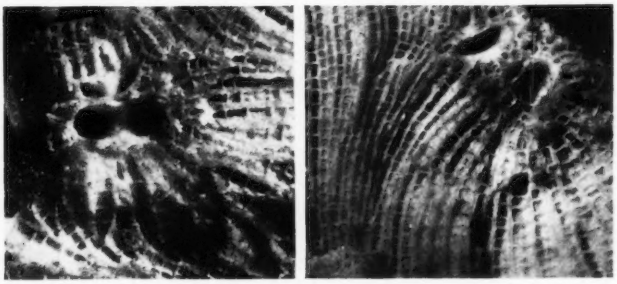
Fig. 5. Comparison of 427 non-dentate (solid line) and 418 dentate (broken line) shells of *Polygyra thyroides* from White Heath, Illinois.

Streptindytes chaetetiae a New Species of "Parasitic" Annelid Found on Chaetetes radians

Vladimir J. Okulitch

While working on *Chaetetes radians,* a coral from the Carboniferous of the Government of Moscow, Russia, I noticed a curious structure in some of the coralla. A closer examination revealed that these objects were tubes of a spiral annelid tube embedded in the coral. Dr. P. E. Raymond called my attention to the very similar cases of primitive "parasitism" (i.e., commensalism) described by John M. Clarke in his book on "Organic Dependence and Disease: Their Origin and Significance." (Yale University Press, 1921).

The annelid tubes under question resemble greatly *Streptindytes compactus* from the Upper Devonian of Iowa, but slight differences in shape, a different host, and the chronological and geographical difference, suggest at least a specific difference.



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Figs. 1-2. *Streptindytes chaetetiae* sp. nov. Fig. 1, x 5; Fig. 2, x 6.

Streptindytes chaetetiae sp. nov.

Diagnosis:—A tube of a spiral annelid imbedded in *Chaetetes radians* Fisher from the Carboniferous of Russia. The tubes are 0.9 mm. or less in diameter, made of fine grained, dense, white calcite. In the holotype the tube makes two complete volutions, leaving a central structure resembling the columella of the gastropods. The inner and outer surfaces of the tube are perfectly smooth. The tube in cross-section is nearly circular, or slightly elliptical.

The corallites of *Chaetetes* partly abut the tube and partly are deflected around it. A considerable number of corallites are attached to the tube, using it as a support. In every case the walls of adjacent corallites and the wall of the tube appear to be almost completely amalgamated. The embedded worm may have been strangled by the more rapid growth of the coral, as no outlets of the tube are visible, or it may have died before the corallum ceased to grow.

Remarks:—The new species differs from *Streptindytes compactus*, as illustrated and described by Clarke, in having a more rounded tube, nearly circular in cross-section, the absence of sharp edge running along the outside of the tube, a somewhat thicker "columella," which suggests that the worm was more loosely coiled; and is found in a different host.

Holotype:—Deposited in the Museum of Comparative Zoology, at Harvard University.

This work was done in the course of research carried under a grant of the Carnegie Fellowships Board of the Royal Society of Canada.

The Atlantic and Gulf Coast Tertiary Pectinidae of the United States[1]

H. I. Rowland [2]

II.—SYSTEMATIC DESCRIPTIONS, Continued

Genus CHLAMYS Bolten, 1798.

Chlamys Bolten, Mus. Bolt.: 161, 1798, lists *C. cinnabarina* Bolten, *C. islandica* Linné, etc.; Herrmannsen, Ind. Gen. Mal., **1**: 231, 1846, designates as type *C. islandica* Linné; Mörch, Cat. Conchyl., **2**:57, 1853; H. and A. Adams, Gen. Moll., **2**:553, 1858; Stoliczka, Geol Surv. India, Mem. **3**:425, 1871, cites *P. bifrons* Lamarck as type; Tryon, Struct. and Syst. Conch., **1**:289, 1882; Verrill, Conn. Acad. Sci., Trans., **10**:58, 1899; Fischer, Man de Conch.: 945, 1887, *partim:* Sacco, I. Moll. Terz. del Piemonte e della Liguria, **24**:3, 1897; Dall, Wag. Free Inst. Sci., Trans., **3**:695, 1898; Arnold, U. S. Geol. Surv., Prof. Pap., **47**:49, 1906; Ugolini, Pal. italica, **12**:157, 1906, cites *C. varia* Linné as type; Cossman and Peyrot, Actes de la Soc. Linn. de Bordeaux, **66**:310, 1914; cites *Pecten islandicus* Linné; Dautzenberg and Fischer, Trav. de la Sta. Biol. de Roscoff, fasc. **3**:111, 1925, cites *C. islandica* Linné as type; Woodring, Carnegie Inst. Wash., Publ., **366**:64, 1925; Gardner, U. S. Geol. Surv., Prof. Paper, **142-A**:45, 1926; Cox, Zanzibar Protect; 43, Sept., 1927; Grant and Gale, San Diego Soc. Nat. Hist., Mem., **1**:161, 1931, *partim;* Marwick, New Zealand Geol. Surv., Pal. Bull., **13**; 61, 1931; Makiyama, Kyoto Imp. Univ., Mem. College Sci., ser. B: **10**:(2):133, 1934, cites as type *C. cinnabarina* Bolten and Röding=*Ostrea islandica* Gmelin, 1791, =*Ostrea cinnabarina* Born, 1780.

Pecten Klein, Stoliczka, Geol. Surv. India, Mem., **3**:424, 1871, cites as type *P. varius* Linné, *partim;* H. and A. Adams, Gen. Moll., **2**:550, 1858, lists *P. varius* Linné, etc., *partim.*

Genotype.—*"Ostrea" islandica* Linné, by subsequent designation, Herrmannsen, 1846,=*Pecten islandicus* Müller, Prodr. Zool. Dan. p. 248, 1776. Recent, circumboreal.

Diagnosis.—Shell suborbicular or trigonal; equivalve, or with one valve slightly the more convex; commonly inequilateral. Auricles unequal; byssal sinus variable in depth; ctenolium variably developed. Resilium internal, central, trigonal. Auricular and cardinal crura sometimes present. Adductor muscle scar excentric, posterior.

Remarks.—Bolten included the majority of species listed by Lamarck in the genus *Pecten* under *Chlamys*. H. and A. Adams adopted *Chlamys* for a small, poorly defined section of *Pecten*, s.l., while most of the more typical

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1 Dr. C. W. Merriam, of Cornell University, has read this section of the manuscript, and those which will appear later, and has offered vaaluable suggestions.

2 H. I. Rowland (Mrs. R. A. Rowland)=H. I. Tucker, who appears under that name as author of Part I, this journal **17**(2):1936.

species cited by Bolten were retained in *Pecten*. Genus *Pecten* of H. and A. Adams, type *P. varius*, is practically the same as *Chlamys* of Bolten.

Fischer, 1887, adopted *Chlamys*, s.l., for the greater part of the *Pectinidae*, including such groups as *Pallium*, *Pseudamussium*, *Lyropecten*, *Camptonectes*, etc. *C. islandica* Linné was cited as type of the restricted section of *Chlamys*.

Stoliczka, 1871, adopted *Chlamys* is a more restricted sense, with *P. bifrons* Lamarck as type. *Chlamys* as defined by Stoliczka equals *Aequipecten* Fischer, 1866.

Herrmannsen, 1846, adopted *Chlamys*, s.s., and designated *C. islandica* Linné as type. Cossman and Peyrot, 1914, were the first workers to assign full generic value to the restricted *Chlamys*, genotype *C. islandica* Linné.

Range.—World wide (fossil). Living in the cooler seas.

Horizon.—Jurassic to Recent.

Subgenus CHLAMYS, s.s.

Diagnosis.—Shell subequivalve; height usually greater than the width; dorsal margins steep. Radial sculpture consists of narrow ribs which frequently become dichotomous toward the ventral margin; concentric sculpture of scaly lamellae; anterior auricle the longer; byssal notch deep; well defined ctenolium.

Chlamys (Chlamys) rigbyi (Whitfield)
Pl. 10, Fig. 7.

Pecten rigbyi Whitfield, U. S. Geol. Surv., Mon. **9**:226, pl. 29, fig. 6, 1885; Dall, Wagner Free Inst. Sci., Trans., **3**: 736, 1898.

Description.—Whitfield's original description:

Shell small, circular in outline exclusive of the auriculations, and moderately ventricose on the right valve; ears rather large, the anterior one nearly twice as long as wide, and the byssal notch below it deep; posterior ear nearly or quite as long, but shorter on the hinge-line than where it joins the body of the valve, making the hinge-line a little more than half as long as the width of the shell below. Surface of the shell marked by from twenty-two to twenty-six radiating ribs, which are strong in the middle of the valve and gradually decrease in strength toward the sides. Surface of the ribs crossed by very distinct, imbricating, concentric lamellae. Auriculations on the right valve both marked with radiating ribs and comparatively strong concentric lamellose lines. Left valve unknown.

This species is associated with *Pecten Kneiskerni Conrad*, but may be distinguished from that one by the comparatively coarser radiating ribs.

Dimensions.—Holotype: Height 15, width 13 mm.

Locality.—Shark River, N. J., [Whitfield].[3]

Horizon.—Shark River (Eocene).

Holotype.—American Museum of Natural History, Cat. No. $\frac{9716}{1}$

3 Names in brackets are those of collectors.

Chlamys (Chlamys) greggi Harris

Pl. 6, Fig. 10; Pl. 10, Fig. 4.

Chlamys greggi Harris, Bull. Am. Pal., **2**(9):45, pl. 7, figs. 4-5, 1897.
Pecten (Chlamys) greggi Harris; Dall, Wagner Free Inst. Sci., Trans., **3**:738, 1898.

Description.—Harris' original description:

General appearance as figured; exterior with about 25 or 30 strong, smooth, sharply defined ribs radiating from the beak without bifurcation, ears with 5 or 6 radiating folds or costae; interspaces about twice the breadth of the ribs, anteriorly and posteriorly showing the microscopic ex-curving striae of *Camptonectes*.

This species is of nearly the form and size of *C. choctavensis* from which it is distinguished by its small number of ribs, its lack of costal bifurcation and imbrication, and the presence of *Camptonectes* structure in the interspaces.

Right valves of this species are somewhat gibbous.

Shell thin, ovate, the right valve somewhat the more convex. Ribs 21-30; simple, smooth, rounded, sharply elevated. Interspaces rounded, usually twice as wide as the radials. Camptonectes marking strongly developed in the interspaces, especially anteriorly and posteriorly, and on the narrow submargins, but somewhat less marked on the auricles. Usually 5 or 6 faint radials on the auricles; stronger on the right anterior basal auricle. Byssal notch deep, conspicuous; slight fasciole. Auricles small, the right anterior one somewhat longer. Ctenolium absent.

Specimens from Yellow Bluff, Ala., tend to be more strongly and equally convex. Ribs appear sharper and interspaces much wider. Ribs rarely increase by bifurcation.

Remarks.—*C. greggi* is separated from *choctavensis* by its fewer, narrow, simple ribs and stronger development of camptonectes marking.

Dimensions.—Syntypes: Right, height 22, length 21 mm.; left, height 20, width 18 mm. Hypotypes: Right, height 14, width 12 mm.; left, height 18, width 16 mm.

Localities.—Yellow Bluff (right valve), Gregg's Landing (type, and left valve); Bell's Landing, and Lower Peach Tree Landing, Ala., [Harris]; Ft. Gaines, Ga., [Harris].

Horizon.—Wilcox (Eocene).

Syntypes and hypotypes.—Paleontological Research Institution.

Chlamys (Chlamys) caini (Harris)

Pl. 5, Fig. 11.

Pecten wautubbeanus var. *caini* Harris, Bull. Am. Pal., **6**:24, pl. 14, fig. 8, 1919.

Description.—Harris' original description:

This is characterized by the broad, simple ribs ornamented with densely arranged, imbricate concentric lines.

The holotype resembles *wautubbeanus* in outline though the shell is thicker than in that species. Strong radial sculpture of 16 round, high, simple ribs. Near the periphery, some of ribs show a very slight tendency to develop sulci on their summits, giving them an obscurely tri-partite appearance. An occasional small intercostal near the posterior and anterior margins. Ribs

narrower and more closely spaced near the submargins. Interspaces rounded, deep, only slightly narrower than the ribs at the periphery. Strong concentric sculpture of thin, widely spaced, elevated lamellae which cross the ribs and interspaces. About 4.5 mm. from the margin of the disk the lamellae are slightly reflected backward on the summits of those ribs which tend to develop sulci. The lamellae form small scales on the summits of the intercostal threads. Six radial rows of scales on the anterior auricle of the holotype.

Remarks.—This species is separated from *wautubbeanus* by its broader, simpler ribbing, and strong concentric sculpture.

Dimensions.—Holotype (figured), height 21, width 19 mm.

Localities.—Wautubbee (type), and Hickory, Miss. [Harris].

Horizon.—Claiborne (Eocene).

Holotype.—Paleontological Research Institution.

Chlamys (Chlamys) sheldonae Tucker

Pl. 6, Figs. 5, 8.

Chlamys (Chlamys) sheldonae Tucker, Amer. Midl. Nat. **15**(5):614, pl. 27, fig. 2, 1934.

Description.—The original description:

Shell thin, subovate, very inequilateral, convex, strongly sculptured, auricles unequal. Sixteen primary ribs, which in the umbonal region are simple, rounded and narrower than the interspaces. About 8 or 10 mm. from the margin the ribs tend to develop a marked sulcus on their summits, and frequently become dichotomous. At about the same point there appear from 1 to 3 scabrous intercostals. Usually the primary ribs develop a single row of conspicuous, fluctuated scales on their summits before they become sulcate. On the anterior and posterior portions of the disk the scaly threads alternate in strength, becoming finer toward the submargins, the auricles, and in the interspaces. Six to seven radiating, scaly threads on the auricles. Fine provinculum. Margin of disk crenulated, obsolete grooves extend nearly to the beak.

Remarks.—This species has fewer ribs and stronger camptonectes marking than *C. choctavensis* Aldrich. That species lacks the strong scabrous sculpture so well developed in *sheldonae*. *C. choctavensis* is equilateral, *sheldonae* quite inequilateral.

Dimensions.—Holotype (figured), height 22, width 18, convexity 6 mm.

Locality.—Ft. Washington, Md. (type), [Tucker].

Horizon.—Aquia (Eocene).

Holotype.—Collection H. I. Rowland.

Chlamys (Chlamys) choctavensis (Aldrich)

Pl. 6, Fig. 7; Pl. 9, Fig. 6.

Pecten chocatavensis Aldrich, Bull. Am. Pal., **1**: 16, pl. 5, fig. 7, 1895; Clark and Martin, Md., Geol. Surv., *Eocene;* 188, pl. 44, figs. 4-6, 1901.

Chlamys choctavensis Aldrich; Harris, Bull. Am. Pal., **2**:238, pl. 7, fig. 6, 1897.

Pecten (Aequipecten?) choctavensis Aldrich; Dall, Wagner Free Inst. Sci., Trans., Free Inst. Sci., Trans., **3**:733, 1898.

Description.—Aldrich's original description:

Shell suborbicular thin, depressed, finely, closely ribbed, ribs showing through the substance of the shell, imbricated near ventral margin and on the anteror slope; ears ribbed and ribs imbricated with fine, oblique reticulations between.

Ribs wider than the flat interspaces which frequently show camptonectes marking. Primary radials increase by dichotomy and intercalation. An occasional specimen from Woods Bluff, Ala., has scaly threads in the interspaces near the periphery; in some cases, scales are developed on the summits of the primaries. Rarely a valve shows fine, inconspicuous, concentric growth lines. Auricles unequal; some having camptonectes marking; there are 5 or 6 scaly radials on left valve; 3 or 4 on right. Deep sulcus-like fasciole; byssal notch deep, rather narrow. Ctenolium of 3 or 4 denticles; provinculum; ribbed internally.

Shells from the type locality, identified by Aldrich, deposited in the collections of the Johns Hopkins University, have about 38 rounded, elevated ribs which are nearly as wide as the interspaces. Ribs increase chiefly by intercolation. Scaly intercostals extend about 2 mm. from the periphery. The anterior and posterior slopes have scaly intercostals extending further toward the beak and the primary ribs have tiny scales on their summits. Camptonectes marking best developed near the anterior and posterior margins of the valves.

Dimensions.—Holotype, height 19, width 17 mm. Hypotype, another left valve, height 19, width 15 mm.

Localities.—Pope's Creek, 1.5 mi. above Pope's Creek; Upper Marlboro, 1 mi. northeast of Piscataway, Southeast Creek, Md., Clark and Martin; Woods Bluff, Choctaw County, Ala. (hypotype), [Aldrich]; Choctaw Corners, Bashia Creek, Ala. (type), [Aldrich]; Newcastle, Va.

Horizon.—Aquia, Nanjemoy, Claiborne, Wilcox (Eocene).

Hypotype.—Collection of G. D. Harris, Ithaca, N. Y.

Holotype.—Collection The Johns Hopkins University.

Chlamys (Chlamys) johnsoni (Clark)

Pl. 10, Fig. 1.

Pecten johnsoni Clark, Johns Hopkins University Circulars, **15**(121:5, 1895; Clark, U. S. Geol. Surv., Bull. **141**:44, 85, pl. 34, figs. 3a, 3b, 1896; Dall, Wag. Free Inst. Sci., Trans., **3**:736, 737, 1898; Clark and Martin, Md. Geol. Surv., Eocene: 189, pl. 44, figs. 8, 8a, 1901.

Description.—Clark's original description:

Shell small, suborbicular, equilateral; surface with about 20 uniform distant, rounded costae, and a few short costae in interspaces near basal margin, the whole crossed by fine lines of growth.

Interspaces much wider than the ribs. Valve appears reticulated in umbonal region where the concentric sculpture intersects the radial. Camptonectes marking developed in the interspaces near the submargins. Fluted internally.

Remarks.—This species differs from *C. greggi* in having stronger camptonectes marking, and in ribs whose number does not increase peripherally.

Dimensions.—Holotype (figured), height 15, width 14 mm.

Localities.—Potomac Creek, Va. (type), [Clark]; Woodstock, 2 miles below Potomac Creek, Potomac Creek, Mouth of Pasopotansa Creek, Md., [Clark and Martin]; Clark County, Miss.

Horizon.—Nanjemoy and Aquia (Eocene).

Holotype.—Collection of The Johns Hopkins University.

Chlamys (Chlamys) clarkeanus (Aldrich)

Pl. 5, Fig. 1; Pl. 7, Fig. 6; Pl. 10, Figs. 5, 12.

Pecten clarkeanus Aldrich, Bull. Am. Pal. **1**:68, pl. 5, fig. 11, 1895; Harris, Bull. Am. Pal., **6**:25, pl. 15, figs. 8, 9, 13, 1919, *partim.*

Pecten rogersi Clark, Johns Hopkins Univ. Circ., **15**(121):5 (Not *P. rogersi* Conrad, Acad. Nat. Sci. Phila., Jour., **7**:151, 1834), Oct., 1895; Clark, U. S. Geol. Surv., Bull. **141**:85, pl. 34, figs. 2a-2c, 1896.

Pecten (Pseudamusium) frontalis Dall, Wagner Free Inst. Sci., Trans. **3**:753 (Renamed *P. rogersi* Clark), April, 1898.

Pecten dalli Clark, Johns Hopkins Univ. Circ., **18**: No. **137**:18 (Renamed *P. rogersi* Clark after Dall had renamed the same species *P. frontalis*), Nov., 1898; Clark and Martin, Md. Geol. Surv., *Eocene:* 188, pl. 44, figs. 7, 7a, 7b, 1901.

Pecten (Chlamys) clarkeanus Aldrich; Dall, Wagner Free Inst. Sci., Trans., **3**:739, 1898, *partim.*

Pecten (clarkeanus? var.) *burlesonius* Harris, Bull. Am. Pal., **6**:26, pl. 14, figs. 11, 12, 13, 1919.

Description.—Aldrich's original description:

Shell orbicular compressed; ears nearly equal; beaks pointed; both valves about equal; the right one convex, the umbones more slightly convex, the apex of valves smoother very minutely striated the lower and older parts strongly marked with about 48 radiating ribs, strongest on the right valve, anterior ear on right valve with a sinus; ears striated.

This species combines the characters of two subgenera. The ribs in some specimens are quite plain near the beaks, then become obsolete and suddenly reappear below, where they often bifurcate. Examined under a glass, the ribs appear to be smooth and rounded; on the left valve the beaks are ribbed, but on the right they appear to be smooth. Young specimens are difficult to distinguish from *P. Scintillatus* Conrad.

Specimens figured by Harris, (pl. 15, figs. 8, 9, 1919), from Sowilpa Creek, Ala. are not quite typical. Fig. 9 is a worn valve. The bifurcating ribs of fig. 8 are characteristic.

The holotype is essentially as figured, Bull. Am. Pal., **1**(2): pl. 5, fig. 1895, save that the ribs on the auricles are poorly defined. There are five on the anterior and four on the posterior auricle. In two less well preserved valves from the type locality, the apex and older portion of the shell are smooth, while well defined ribs appear abruptly on the younger portion of the disk.

The syntype (U. S. National Museum, Cat. No. 154227), from Black Bluff Shoals, Brazos River, Texas, is ribbed, except on the beak where the radials are eroded. Camptonectes marking is present. Auricles have three ribs. Internally they are lirate for about 5 mm. from the ventral margin.

Several valves from Talahatchee, Miss. show wide variation in sculpture; the largest valve is 12 mm. high. Valves sub-equally convex; translucent; beaks of left valves slightly more pointed than those of the right. Radial

sculpture slightly stronger on left valves; concentric is stronger on right valves. Ribs may be nearly obsolete over the whole disk and strong only peripherally, well developed over the whole disk; or strong only on the beak and at the ventral margin. Ribs rounded, frequently well elevated, of about same width as interspaces; they increase by dichotomy near the periphery, and by intercolation. On a few shells, intersection of concentric and radial sculpture in the umbonal region gives a somewhat beaded appearance. Strong camptonectes marking is constant, occurring on disk and portions of the auricles. Auricles subequal, the myssal being much longer than the right posterior auricle. Internal ventral margin sometimes obscurely lirate.

Umbonally, the valve of *burlesonius* figured by Harris (pl. 14, fig. 11, 1919), shows a fairly strong radial sculpture which continues along the anterior and posterior slopes and appears at the ventral margin. Camptonectes marking over whole disk and auricles. Three or four radials on auricles. This valve appears to be worn, as does another specimen from the type locality. In it, radial ribbing is well developed at the periphery. On the beak the intersection of concentric and radial sculpture gives an obscurely beaded appearance. Camptonectes marking well developed. Three radials on the auricles.

Remarks.—This species is intermediate between *Chlamys* and *Pseudamusium*. Certain forms, such as *A. hamiltonense* Tucker, which have been placed in *Chlamys* clearly are not referable to that genus. Valves of the type designated *burlosonius* by Harris show a range of variation in the mode of development of radial sculpture. Examination of many specimens from the Texas Eocene indicates that this variety should be referred to *clarkeanus*.

C. clarkeanus is separated from *C. scintillatus* by its sculpture. The latter species is never radially sculptured and has much better developed camptonectes marking. *A. hamiltonense* has very much less well developed radial sculpture, and a characteristic row of scales at the base of the auricles of the left valve.

Dimensions.—Left valve, height 18, width 17 mm., (Black Bluff Shoals, Brazos River, Texas, U. S. National Museum, Cat. No. 154227). Left valve, height 11, width 9 mm., (Hamilton Bluff, Ala., collection G. D. Harris). Right, height 13, width 12 mm., (Negreet Bayou, La. Both in G. D. Harris' collection, types of *burlesonius*).

Localities.—Potomac Creek, and Southeast Creek, Md., Clark; Sowilpa Creek, Ala. (type), [Aldrich]; Hamilton Bluff, Ala., [Harris]; Black Bluff Shoals, Collier's Ferry, Smithville, Texas, [Harris]; Negreet Bayou, and Chautaqua, La., [Harris].

Horizon.—Pamunkey, Claiborne, and Jackson (Eocene).

Syntypes.—Of *burlesonius*, Paleontological Research Institution, Ithaca, N. Y.

Holotype.—Collection of The Johns Hopkins University.

Chlamys (Chlamys) wautubbeanus Dall
Pl. 5, Figs. 7-9; Pl. 9, Fig. 4.

Pecten (Chlamys) wahtubbeanus Dall. Wagner Free Inst. Sci., Trans., **3**:736, pl. 34, fig. 9, 1898.

Pecten wautubbeanus Dall; Harris, Bull. Am. Pal., **6**:21, pl. 14, figs. 1-4, 1919.

Description.—Dall's original description:

Shell small, flattish, with small, unequal ears and rounded disk; fourteen or fifteen ribs carrying basally three densely finely imbricated, rounded threads, the interspaces narrower with two crenulate threads; submargins with close, fine imbricate threads; ears prominent, with a deep, wide byssal notch, radiately imbricate with coarse, elevated radial threads; interior with shallow sulci, the cardinal crura developed but no lirae on the disk.

C. wautubbeanus is an extremely variable species. The right valve appears to be the more common and is more apt to have a worn appearance. The left valve is usually flatter than the right and it is much less apt to show bi-or tri-partite marking. Secondary sculpture is less well defined on the left valve, while on the right it commonly appears after a distinct line of growth, or near the margins of the valve. Ribs rounded and narrower than the interspaces. Byssal auricle has 3 coarse, radial threads; right posterior auricle has 3 faint, scaly, radial threads near the submargin. Concentric lamellae continue across the auricles. Ctenolium of four or five denticles.

The holotype has simple, rounded, elevated ribs, much narrower than the interspaces. About 11 mm. from the beak the scabrous sculpture begins. Some specimens from the type locality have ribs less well developed in the umbonal region and show bi-, or tri-partite marking about 2 mm. from the periphery.

An adult left valve, height 19.5 mm., from Enterprise, Miss., has faint radials extending to the umbonal region from the beak and becoming obsolete on the disk. Within 2 mm. of the margin the radials are strongly developed. Posterior auricle ribbed. Anterior smooth. Ctenolium present. Specimens from St. Maurice, La. appear slightly more convex than those from other localities.

Remarks.—This species is separated from *johnsoni* by its less numerous ribs, which increase by dichotomy rather than by intercolation. *C. dehayesi* has 21 ribs.

Dimensions.—Holotype, height 17, width 16 mm. Right valve, height 15, width 12 mm. Right valve, height 10, width 8 mm., (Hickory, Miss.).

Localities.—Wautubbee, near Newton, Miss. (type), [Johnson]; Hickory and Enterprise, Miss.; Orangeburg, S.C.; Indian Mound Railroad Cut, Newton County, Miss., [Harris]; Newton County, Miss., [Dall]; Coffeeville, Ala., [Harris].

Horizon.—Claiborne and Jackson (Eocene).

Hypotypes.—Paleontological Research Institution.

Holotype.—U. S. National Museum, Cat. No. 137612.

Chlamys (Chlamys) wautubbeanus willcoxi (Dall)
Pl. 5, Fig. 10; Pl. 10, Fig. 2.

Pecten (wahlubbeanus var.?) *willcoxii*, Dall. Wagner Free Inst. Sci., Trans., **3**:737, pl. 29, fig. 4, 1898; Harris, Bull. Am. Pal., **6**:23, pl. 14, figs. 6, 7, 1919.

Description.—Dall's original description:

Shell small, broad, flattish, thin, left valve with about sixteen narrow, rounded elevated ribs, with somewhat sparse, regularly spaced prickles on their tops; between the ribs are similar, but lower and smaller, non-dichotomous radial threads; submargins very narrow, nearly plain, with faint *Camptonectes* striation; ears small, subequal, except the byssal ear, which is longer, narrow, with a deep sinus and conspicuous fasciole, and about six scabrous radii, the right posterior ear with concentric striae and only faint traces of a few radii; the ears on the left valve similar, with five or six strong scabrous threads; internal basal margin of left valve with short flutings in harmony with the radial sculpture; the disk not grooved; in the right valve the internal channels are more pronounced; the right hinge-line has single crural ridge parallel with the margin on each side of the pit.

Primary ribs of the holotype dichotomize; intercostals intercalate. Posterior auricle has only three obsolete radials near the submargin; byssal auricle has five coarse, scabrous radials; auricles elongated, elevated. Wide, deep, conspicuous fasciole; ctenolium and provinculum present; shell fluted to umbones.

Remarks.—This subspecies is separated from *wautubbeanus* by the erect scales on the summits of the ribs. *C. willcoxi* is separated from *C. membranosus* by its radial sculpture, thinner shell. The radial threads of *membranosus* tend to be fasciculated while those of *willcoxi* are not.

Dimensions.—Holotype, height 29, width 27 mm. Hypotype, height 21, width 19 mm.

Localities.—Clarke County, Miss. (type); Wautubbee Hills, Miss., [Johnson and Burns]; Negreet, La.; Sabine River, Texas (hypotype), [Harris].

Horizon.—Claiborne (Eocene).

Hypotype.—Collection G. D. Harris, Ithaca, N. Y.

Holotype.—U. S. National Museum, Cat. No. 140126.

Chlamys (Chlamys) dehayesi (Lea)
Pl. 5, Figs. 2-5.

Pecten dehayesii Lea, Cont. to Geol.; 87, pl. 3, fig. 66, 1833; Conrad, Am. Jour. Conch., **1**:14, 1865; Heilprin, Acad. Nat. Sci. Phila., Proc., **31**:220, 1879; Heilprin, *op. cit.*, **33**:414, 417, 1881; Meyer, Am. Jour. Sci., **31**:69, 71, 302, 306, 307, 423, 425, 1886; Heilprin, Acad. Nat. Sci. Phila., Proc., **38**:57, 1886; Longden, Am. Jour. Sci., **31**:208, 1886; de Gregorio, Ann. Geol. et Pal., **7** et **8** liv.: 180, pl. 21, figs. 12-15, 1890; Dall. Wag. Free Inst. Sci., Trans., **3**:738, 1898; Harris, Bull. Am. Pal., **6**:19, pl. 13, figs. 2-4, 6, 7, 1919; Kellum, U. S. Geol. Surv., Prof. Paper **143**:19, 1926.

Pecten lyelli Lea, Cont. to Geol.: 88, pl. 3, fig. 67, 1833; Tuomey, Ala. Geol. Surv., First Biennial Report: 148, 1850; Hilgard, Agri. and Geol. Miss.: 126, 1860; Meyer, Am. Jour. Sci., **(3)**:**29**:459, 1885; Meyer, *op. cit.*, **30**:71, 1885.

Description.—Lea's original descriptions:

P. dehayesi: Shell orbicular, rather compressed; ears nearly equal; substance of

the shell rather thick; ribs about twenty-one, large, alternating with as many small ones, all imbricate; beaks pointed.

P. lyelli: Shell longitudinal, rounded below, angular above, compressed; ears very unequal, having a channel on the larger one; substance of the shell thin; ribs about twenty-two, rounded, slightly imbricate; beaks acutely angular.

On left valves of the type designated *dehayesi,* ribs have about as wide as the flat interspaces. One strong scabrous intercostal with a smaller one on either side appear near the base of the ribs. Primary ribs increase by dichotomy and intercalation. Concentric lamellae form a row of scaly projections on the intercostals, and usually two or three rows on the somewhat flat-topped ribs near the margin of the shell. Camptonectes marking especially well developed anteriorly and posteriorly in the interspaces and on the auricles bordering the submargins. About 10 scaly radials on the subequal auricles of adult valves.

Right valves, of the *lyelli* type, are simple, rounded, and concentrically lamellated umbonally. Near periphery, the ribs develop a sulcus which gives a bipartite effect. Ribs tend to dichotomize. Interspaces somewhat rounded. Intercostals usually one to three; concentric lamellae and camptonectes marking less well developed than on left valves. Auricles unequal, radially threaded, lamellated. Byssal notch wide, deep, conspicuous; broad fasciole; no ctenolium. Margins fluted internally.

Holotype of *dehayesi* Lea, an orbicular, somewhat convex left valve, has a height of 33 and width of 32 mm. About 20 primary, uniform, rounded radials. One major intercostal; sometimes one or two minor ones appear about 18 mm. from the margin. Concentric lamellae reflected beakward as they cross the radials. Nearly equal, radially threaded auricles. Internally, obsolete ribs are stronger at the margins than umbonally.

Holotype of *lyelli* Lea (Collection Academy of Natural Sciences of Philadelphia, Cat. No. 5426), a right valve from Claiborne, Ala., shows: height 19, width 18 mm. Twenty-one rounded, concentrically lamellated ribs. Very small intercostal radial threads near margins. Deep byssal notch; fasciole. Ctenolium present; internal ribs obscure.

Dimensions.—Right valve, height 18, width 15 mm.; another right valve, height 25, width 21 mm. Left valve, height 19.5, width 15 mm.; another left valve, height 35, width 30 mm. All from Claiborne, Ala.

Localities.—Claiborne, Ala. (type), [Lea]; Orangeburg, S. C., [Harris]; St. Stephens Bluff, Ala.; Live Oak, Fla.; Enterprise, Miss.; Wilmington; 0.5 mi. northwest of Winstatt Station; 0.75 mi. southwest of Comfort Station, Jones County, N. C., [Kellum].

Horizon.—Claiborne (typically), and Jackson (Eocene).

Hypotypes.—Paleontological Research Institution.

Holotype.—Academy of Natural Sciences of Philadelphia, Cat. No. 5425.

Chlamys (Chlamys) dehayesi tirmus (de Gregorio)
Pl. 10, Fig. 10.

Pecten dehayesii Mut. *tirmus de* Gregorio, Ann. de Geol. et Pal., **7** et **8** liv.: 181, pl. 21, fig. 15, 1890.

Pecten wautubbeanus var. *tirmus* de Gregorio; Harris, Bull. Am. Pal., **6**:23, pl. 14, fig. 5, *partim*, 1919.

Description.—de Gregorio's original description:

Testa elegans, costis bipartitis ornata.

Shell large, thin, nearly orbicular, slightly convex, pointed. Twenty-two scabrous ribs, which tend to develop sulci on their summits about 15 mm. from the ventral margin, giving the bi-partite effect noted by Harris. Ribs in the umbonal area, rounded, simple. A single scaly cord appears in interspaces shortly before the sulcus develops on the summits of the primary radials. Rarely a second smaller intercostal appears. Submargins sculptured by scaly radial cords. Auricles subequal; usually about seven scaly radial threads.

Remarks.—This subspecies is distinguished from *dehayesi* by its thinner shell, more orbicular outline and more numerous bipartite ribs. The shell of *tirmus* is thinner than that of *C. N. dennisoni*, less convex, and has more numerous bifid ribs.

Dimensions.—Hypotype, height 32, width 30 mm.

Locality.—Claiborne, Ala. (type), [de Gregorio].

Horizon.—Claiborne (Eocene).

Hypotype.—Paleontological Research Institution.

Chlamys (Chlamys) dehayesi dennisoni Tucker
Pl. 5, Fig. 6.

Pecten dehayesii Lea, var., Harris, Bull. Am. Pal., **6**:23, pl. 14, fig. 5, 1919, *partim*.

Chlamys (Chlamys) dehayesii dennisoni Tucker, Amer. Midl. Nat. **15**(5):613, pl. 26, fig. 1, 1934.

Shell large, heavy, orbicular, convex, slightly inequilateral; beak pointed, shell expands rapidly in width. Sixteen strong, simple, rounded ribs which are wider than the flattened interspaces. Single thread on the summit of each primary rib extends about 20 mm. from the margin of the disk toward the beak. One strong radial thread in center of each interspace with a secondary on either side near the base of the adjoining rib. Concentric sculpture of overlapping lamellae which are elevated on the intersoctals and on the summits of the ribs. Submargins wide, sculptured with fine, closely spaced, scabrous radial threads. Subequal auricles have the same type of sculpture. Interior ribbed to correspond to the external interspaces.

Remarks.—*C. dennisoni* is much larger than C. dehayesi, more circular in outline, simple in sculpture, less convex in the umbonal area. It is conspicuously larger than other Eocene species.

Dimensions.—Holotype, height 42, width 41, hinge 22 mm.

Locality.—Claiborne, Ala. (type).

Horizon.—Claiborne (Eocene).

Holotype.—Paleontological Research Institution.

Chlamys (Chlamys) cacawensis (Harris)
Pl. 5, Figs. 12-15.

Pecten cacawensis Harris, Bull. Am. Pal., **6**:27, pl. 15, figs. 1-7; pl. 13, fig. 8(?), 1919.

Description.—Harris' original description:

Size and outline as indicated by the figures; surface ornamentation, about 23 ribs on each valve, broad with narrow interspaces on the right, narrower with wider interspaces on the left; rarely signs of intercostae on the right, common on the left; imbricating, fine, concentric, lamellae more pronounced on the right valve.

This form has usually passed under the name *dehayesii*, but it will be seen by examining plates 14 and 15 that the ribs of *cacawensis* are much more sharply defined and differentiated and lack the excessive ornamentation of superimposed riblets with scaly imbrications in high relief. However, both are of the same stock and will doubtless seem to intergrade when enough material is collected from a large number of mid-Eocene localities.

Probably the second specimen figured by Harris (pl. 13, fig. 8), should be included under this species. Shell rather thick, orbicular, somewhat flat; 20 low, rounded dibs, wider than the interspaces; nearly an equal number of intercostals which disappear in the mid-portion of the disk. Fine concentric lamellae give the intercostals a somewhat beaded appearance; eroded from summits of the ribs. Submargins narrow, sculptured only by concentric lamellae. Auricles unequal; two faint radials on the posterior auricle near the submargin; byssal auricle, five or six radials. Byssal notch deep, conspicuous. Ctenolium of two denticles. Margin lirate, obsolete ribs extend to the umbonal region.

Another right valve, in the collections of the Academy of Natural Science of Philadelphia, from Claiborne, Ala., probably belongs to this species. It shows 24 low, sub-quadrangular ribs separated by wide sulci and is concentrically lamellated. Submargins wide, unornamentel, sloping. Left auricle without ornamentation, right with obscure radials. Deep, inconspicuous fasciole. Ctenolium present; it is ribbed internally.

Remarks.—Valves of this species have frequently been referred to *dehayesi* by writers. Its orbicular form and sculpture serve to separate it from that species.

Dimensions.—Syntype, right valve, height 18, width 16 mm. Hypotype, height 32, width 32.5 mm.

Localities.—Columbia Road, 17 miles north of Orangeburg, S.C. (type) Claiborne, Ala. above Newbern, Neuse River, N. C., [Harris].

Horizon.—Claiborne (Eocene).

Hypotypes and *Syntypes.*—Paleontological Research Institution.

Chlamys (Chlamys) kneiskerni (Conrad)
Pl. 10, Fig. 9.

Pecten kneiskerni Conrad, Am. Jour. Conch., **5**:40, pl. 1, fig. 18, 1869; Heilprin, Acad. Nat. Sci. Phila., Proc., **33**:417, 1881; Whitfield, U. S. Geol. Surv., Mon. **9**:224, pl. 29, figs. 3-5, 1885, *partim*.

Pecten (Chlamys) kneiskerni Conrad; Dall, Wagner Free Inst. Sci., Trans., **3**:735, 1898, *partim*.

Description.—Conrad's original description:

Ovate, convex, ribs thirteen, convex, little prominent; anterior and posterior submargins without ribs; ears equal (Cast).

Shell subovate, somewhat convex; beak pointed, narrow; disk increases rapidly in width. Radial sculpture consists of elevated, rounded ribs which are narrower than the interspaces. In the umbonal area the ribs are simple; toward the margin they increase by dichotomy and intercalation. Usually conspicuously sulcate at the margin. Occasional small intercostal threads. Ribs 23 at margin. Extending about 10 mm. from periphery toward the beak the concentric, widely spaced lamellae are elevated on the summits of the ribs aand intercostals to form small, slightly reflected scaly processes which extend nearly to the beaks both anteriorly and posteriorly. Probably the concentric lamellae were continuous across the whole disk, but since the holotype is somewhat worn this cannot be definitely determined. Scabrous sculpture occurs on beak. Inter spaces rounded, and on better preserved portions of the cast, have fine, rather closely spaced diagonal striations which are directed away from the beak. This sculpture becomes more marked on the submargins and continues to the ribbed, concentrically lamellated posterior auricle. Submargins narrow, very steep, not radially sculptured. Ribs somewhat more closely spaced and smaller near the submargins.

Both Whitfield and Dall probably described shells not of this species. Shells in the National Museum, (Cat. No. 116013), referred to it by Dall are not *kneiskerni*.

Dimensions.—Holotype, height 25, width 18 mm.

Localities.—Shark River, N. J. (type), [Conrad]; Monroe County, Fla., [Burns]; Enterprise, Miss., [Johnson].

Horizon.—Shark River (Eocene).

Holotype.—George H. Cook Collection at Rutgers University.

Chlamys (Chlamys) beverlyi Tucker

Pl. 8, Figs. 7, 8.

Pecten (Chlamys) gilbertharrisi Tucker, Ind. Acad. Sci., Proc., **40**:243, pl. 1, fig. 1, 1931.

Chlamys (Chlamys) beverlyi Tucker, Amer. Midl. Nat., **15**(5):614, 1934.

Description.—The original description:

Shell ovate; small, rather thin, somewhat gibbous; radial sculpture well developed over general surface of the disk; ten to twelve abruptly elevated, broad, flat ribs, which in the umbonal region appear to be beaded and toward the periphery show distinct bipartite marking. The type has only one or two scaly, radial threads in the interspaces while specimens of apparently the same species from the Jackson of the Sabine River, La., show three or six, one of which, in some cases, is better developed than the others. The ribs of one specimen from this locality increase by dichotomy. Submargins narrow, plain, or ornamented with very fine, obsolete, radial threads. Beak narrow, quite pointed. Ears unequal, sculptured with fine scaly, ..lial threads. Right anterior byssal ear the larger, corrugated near the cardinal margin. Cardinal margin of the right valve bent over that of left valve. Fasciole well marked. Byssal

notch deep, conspicuous. Ctenolium consists of about three or four denticles. Cardinal crura well developed. Provinculum retained in the form of fine lines normal to the cardinal margin.

Remarks.—This species is distinguished from *wautubbeanus* by its fewer, broader, ribs; more oval outline; stronger development of sculpture; shape of the auricles retention of the provinculum.

Dimensions.—Holotype, a right valve, height 18, width 15.5 mm. Hypotype, height 18, width 16 mm.

Localities.—Lisbon, Ala. (type); Sabine River, below Robinson's Ferry, La., [Tucker].

Horizon.—Jackson (Eocene).

Holotype and *Hypotype.*—Collection H. I. Rowland.

Chlamys (Chlamys) membranosus (Morton)

Pl. 9, Figs. 7, 8; Pl. 10, Fig. 11.

Pecten membranosus Morton. Syn. Org. Rem.: 59, pl. 10, fig. 4, 1834; Conrad, Proc. Nat. Inst. Bull. **2**:174, 1842; Hodge, Assoc. Am. Geol. and Nat., Trans.: 97, 1843; Gibbes, Acad. Nat. Sci. Phila., Proc., **2**:254, 1844; Conrad, Am. Jour. Conch., **1**:14, 1865; Heilprin, Acad. Nat. Sci. Phila., Proc., **33**:158, 416, 417, 1881; Meyer, Am. Jour. Sci., **30**:68, 1885; de Gregorio, Ann. de Geol. et Pal., **7** et **8** liv.: 183, 1890; Cook, Ala. Geol. Surv. Rept. **14**:275, 1926.

Pecten carolinensis Conrad, in Kerr, Geol. Surv. N. Car., Rept., App. **A**:18, pl. 3, fig. 2, 1875.

Pecten (Chlamys) membranosus Morton; Dall, Wagner Free Inst. Sci., Trans., **3**:736, 1898; Kellum, U. S. Geol. Surv. Prof. Paper **143**:19, 1926.

Description.—Morton's original description:

Orbicular, convex, somewhat gibbous in the centre, with about eighty distinct costae, the alternate one being smaller.

Adult valves, from Wilmington, N. C., are inequilateral; they vary in development of radial sculpture, some having only strong primary ribs alternating with single intercostals. Radials increase chiefly by intercalation. Young individuals are nearly equilateral and somewhat ovate. Anterior auricles the longer, with four to 5 coarse, imbricated radial threads; byssal auricle much more coarsely threaded. Ctenolium present. Strong cardinal crura. Margins of the chondrophore elevated. Margins of the valve beveled and slightly crenulated. Interior smooth.

Specimens from the type locality are somewhat inequilateral, orbicular and thick. Dense, rounded, scabrous radials increase by intercalation. Valves convex, the left somewhat less so than the right. Young shells much less convex than adults. Auricles small, threaded with numerous scabrous radials. Conspicuous byssal notch. Ctenolium present. Cardinal and auricular crura developed. Margins beveled and crenulated.

Dimensions.—Holotype, height 21, width 19 mm. Hypotypes: Right, height 29, width 26 mm.; left, height 28, width 25 mm.

Localities.—Calcareous strata of South Carolina (type), [Conrad]; Wilmington and 3.5 mi. northwest of Wrightsboro, New Hanover County; Old

Rocky Point quarry; Castle Hayne Quarry; Northeast Cape Fear River 3.5 mi. above Castle Hayne Bridge; 3 mi. northeast of Rose Hill, Pender County; 5 mi. east of Beulaville; 1.5 mi. northeast of Rose Hill; 2 mi. south of Magnolia; and 5 mi. west of Pink Hill, all in Duplin County; 4 mi. south of Richlands; 1 mi. southeast of Richlands, Onslow County; 2.5 mi. west of Dover, Jones County; 3 mi. east of Quinerly, Craven County, N. C., [Kellum].

Horizon.—Jackson (Eocene).

Hypotypes.—U. S. National Museum, Cat. No. 138052.

Holotype.—Academy of Natural Sciences of Philadelphia, Cat. No. 12574.

Chlamys (Chlamys) dansvillensis Weisbord, sp. nov.
Pl. 6, Figs. 4, 6, 12.

Pecten (Chlamys) dansvillensis Weisbord, Mollusca of the Jackson. (Ms.)

Description.—Weisbord's original description:

Shell thin, suborbicular; compressed, with steeply sloping umbonal margins; valves sculptured by 36-40 ribs which are subequal, quadrangular and flat-topped umbonally but more triangular and terraced ventrally; intercostal sulci channeled, slightly narrower than the ribs; on adult specimens a series of concentric lamellae cross the whole, imbricating the ribs. Hinge line straight, with about six radiating riblets and crossed by rather fine, incremental lamellae.

The rather thin shell, fairly numerous ribs which pass from a simple construction umbonally to a terraced, imbricated structure ventrally, serve to characterize this species. It appears to have developed from some such stock as *P. choctavensis* Aldrich from the Sabine Eocene of Alabama.

Dimensions.—Syntypes; young right valve, height 10.5, width 11 mm.; left(?) valve, height 15.5, width 15 mm.

Localities.—Dansville Landing (type), and Tullos, La., [Weisbord].

Horizon.—Jackson (Eocene).

Syntypes.—Paleontological Research Institution.

Chlamys (Chlamys) cushmani (Kellum)
Pl. 9, Fig. 1.

Pecten cushmani Kellum, U. S. Geol. Surv. Prof. Paper **143**:20, pl. 2, fig. 1, 1926.

Description.—Kellum's original description:

Shell equivalve, equilateral with 29 or 30 simple ribs and equal interspaces; concentric sculpture of fine growth lines, which on the ribs tend to form low lamellae; the ribs becoming smaller and crowded near the submargins; ears erect, extent of anterior ear unknown; ctenolium present; posterior ears small and decorated with 5 or 6 radiating ribs, crossed by numerous concentric rows of lamellae; margins of both valves crenulated within, and margin of left valve also beveled within.

Remarks.—The holotype has fine camptonectes marking on the submargins and on the auricles. *C. cushmani* is distinguished from *suwaneensis* by its more numerous ribs, concentric growth lines and crowding of ribs at the submargins. It is less convex than *cookei*, is more nearly equilateral and equivalve, and has ribs much more crowded at the submargins.

Dimensions.—Holotype: height 18, width 17, convexity 2.5 mm.

Localities.—Quinerly Bridge; 3 mi. east of Quinerly, Pitt County; (type), Craven County; 3 mi. north east of Maple Hill, Pender County, N. C., [Kellum].

Horizon.—Jackson (Eocene).

Holotype.—U. S. National Museum, Cat. No. 353314.

Chlamys (Chlamys) cookei (Kellum)

Pl. 7, Fig. 5; Pl. 9, Fig. 5.

Pecten cookei Kellum, U. S. Geol. Surv., Prof. Paper **143**:20, pl. 2, figs. 2-3, 1926.

Description.—Kellum's original description:

Shell suborbicular, slightly oblique, moderately convex, and nearly equivalved, the left valve being more convex; 28-31 rounded ribs with equal interspaces; ribs crossed by concentric rows of imbrications, which toward the periphery and submargins tend to be produced into blunt spines; the interspaces sculptured with extremely minute diagonal striations; anterior ears larger, right anterior sculptured with three strong ribs, which are crossed by numerous rows of coarse lamellae; posterior ears oblique, with less pronounced radiating ribs and concentric imbrications; byssal notch approximately one-half the length of the ear; ctenolium present; interior of valves grooved in accordance with external ribbing; the grooves becoming faint over the medial portion of the disk.

Remarks.—This species is more oblique than *suawaneensis,* has more numerous ribs with shallower interspaces, and bears less angular grooves on the inner margin.

Dimensions.—Holotype, height 14, width 12 mm. Hypotype, left valve from type locality, height 17, width 16 mm.

Localities.—3 mi. south Magnolia (type); Northeast Cape Fear River; 6 mi. west of Pink Hill; Northeast Cape Fear River, near Chinquapin all in Duplin County; near Broadhurst Bridge over Neuse River and Sarpony Hills, Wayne County; 2.5 miles west of Dover and 2 mi. northwest of Wilcox Bridge over Trent River, Jones County, N. C., [Kellum].

Horizon.—Jackson (Eocene).

Hypotype.—U. S. National Museum, Cat. No. 353234.

Holotype.—U. S. National Museum, Cat. No. 353235.

Chlamys (Chlamys) nuperus (Conrad)

Pl. 10, Fig. 6

Description.—Conrad's original description:

Pecten nuperum Conrad, in Wailes, Geol. Miss.: 289. pl. 14, fig. 11, 1854 (no description).

Pecten nuperus Conrad, Acad. Nat. Sci. Phila. Proc., **7**:259, 1855; Hilgard, Agri. and Geol. Miss.: 131, 132, 134, 135, 1860; Conrad, Am. Jour. Conch., **1**:14, 1865; Hopkins, La. Geol. Survey, 2nd Ann. Rept. p. 12, 1870; Heilprin, Acad. Nat. Sci., (**3**): **29**:459, 1885; Meyer, *op. cit.*, **30**:425, 1885; Langdon, *op. cit.*, **31**:202, 1886; Vaughan, U. S. Geol. Surv., Bull., **142**:50, 1896.

Pecten (Chlamys) nuperus Conrad; Dall, Wagner Free Inst. Sci., Trans., **3**:739, 1898.

Suborbicular, ventricose, with about twenty-three angular prominent ribs, crossed by fine, closely arranged wrinkled lines; ears finely striated obliquely.

A single valve with the ears broken is all of this species in the collection.

Left valves from the type locality tend to be equilateral, with 21 keeled ribs and V-shaped interspaces. Lamellae pass directly across interspaces, are reflected beakward on the summits of the ribs and tend to overlap peripherally. In unworn specimens they probably form erect, linguiform processes on the summits of the ribs. Submargins lack radials but show obscure, concentric lamellae. Auricles sub-equal; fine lamellated radials. Valves ribbed internally for about 10 mm. from the margin. Cardinal, and strong auricular, crura.

The holotype, a right valve, has 22 ribs. Right anterior auricle more coarsely threaded than the left; fasciole conspicuous. Ribs present internally to about 15 mm. from the margin. Right and left valves about equally convex.

Remarks.—This species is separated from *C. perplanus* by its fewer ribs, absence of beaded lateral threads, wider submargins. *C. nuperus* is less convex than *perplanus*.

Dimensions.—Holotype, height 30, width 28 mm. Hypotype, from the type locality, height 27.5, width 25 mm. Another hypotype, (left valve), Cornell University collections, height 22, width 18 mm. (figured).

Localities.—Jackson, Miss. (type), [Conrad]; Grant Parish, La. [Vaughan]; Russel's Springs, Decatur County, Ga., [Pumpelly]; Arredondo, Fla., [Johnson]; Grandview Bluff; Gibson's Landing and Bunker Hill Landing, Ouachita River, La.; Shubuta, Miss.; Chipola River, Fla.

Horizon.—Jackson (Eocene).

Hypotypes.—Collections Cornell University, and the Academy of Natural Sciences of Philadelphia.

Holotype.—Academy of Natural Sciences of Philadelphia.

Chlamys (Chlamys) cocoanus Dall

Pl. 7, Figs. 7, 8.

Pecten (Chlamys) cocoanus Dall, Wagner Free Inst. Sci., Trans., **3**:738, pl. 34, fig. 23, 1898.

Description.—Dall's original description:

Shell small, thin, flattish, oblique, produced behind, with about 25 small, low, entire ribs, rounded above, and about 14 interstitial single smaller threads, the tops of all of which are somewhat sparsely concentrically imbricated, the interspaces showing only incremental lines; ears quite unequal, small, the posterior smaller, each with 5 or 6 low, hardly scaly radii; inside of the valve obsoletely channeled, the cardinal crura developed.

Specimens from Heidelberg, Miss., have three large, strong, rounded ribs on the central portion of the disk, with a smaller one on either side. Summits and sides of the ribs radlally threaded. Except at the margins, concentric growth lines extend across the interspaces. Near the ventral margins the interspaces have radial threads. Submargins narrow, threaded radially. Auricles subequal; coarsely threaded. Strong cardinal crura. Internal fluting reflects external radial sculpture. Some of the shells show a tendency to become slightly nodose, and should possible be referred to *Lyropecten*.

Remarks.—C. *cocoanus* is separated from *membranosus* by its entire and less numerous ribs, anad from *wautubbeanus* by its greater obliquity, its entire, less well developed and less densely imbricated radials.

Dimensions.—Holotype, height 23, width 22 mm. Hypotype, from type locality, height 20, width 19 mm.

Localities.—Cocoa Postoffice, Choctaw County, Ala. (type), [Burns]; Red Bluff, Wayne County, Miss.

Horizon.—Jackson (Eocene).

Holotype and *Hypotype.*—U. S. National Museum, Cat. No. 141025.

Chlamys (Chlamys) biddleanus (Kellum)

Pl. 9, Fig. 2.

Pecten biddleana Kellum, U. S. Geol. Surv., Prof. Paper **143**:20, pl. 2, fig. 4, 1926.

Description.—Kellum's original description:

Shell of medium siz, equilateral; the left valve sculptured by 15 rounded primary ribs, alternating with wider interspaces in which are one or two low secondary ribs; submargins broad, steep, and smooth; ears oblique, sculptured with numerous fine radiating ribs and concentric imbrications; the umbonal point projects slightly above the hinge line; internal character of the valve unknown.

The only specimen of this shell obtained from the type locality is a worn left valve. A single right valve collected at Polloksville, Jones County, N.C. appears to be the same species. The following paragraph is a description of this valve.

Shell similar to the left valve from Biddle Landing; sculptured by 17 rounded ribs and nearly equal interspaces. In the center of each interspace is a simple, very fine secondary rib. Entire surface sculptured with concentric laminae; inner margin strongly crenulated with angular grooves which disappear toward the center of the disk; umbonal point projects above the hinge line. Extent of ears unknown.

Dimensions.—Holotype, height 26.5, width 24.5, convexity 3.5, length of hinge line 12.5 mm.

Localities.—Biddle Landing, Neuse River, Craven County (type), and Polloksville, Jones County, N. C., Kellum.

Horizon.—Jackson (Eocene).

Holotype.—U. S. National Museum, Cat. No. 353236.

Chlamys (Chlamys) indecisus Dall

Pl. 6, Figs. 1-3.

Pecten (Chlamys) indecisus Dall, Wagner Free Inst. Sci., Trans., **3**:744, pl. 34, fig. 3, 1898.

Pecten indecisus Dall, Cooke, U. S. Geol. Surv., Prof. Paper **95-I**:110, 1915.

Description.—Dall's original description:

Shell thin, moderately convex, ovate, with about 26 to 34 small, low, simple, entire ribs separated by about equal interspaces and having a tendency, especially in the left valve (which is slightly more convex than the other) to become obsolete distally; transverse sculpture only of lines of growth, Camptonectes striation present, more conspicuous in the smoother specimens; ears small, unequal, the posterior smaller; byssal ear with a well marked notch and a conspicuous fasciole, above which are about 6 partly scabrous riblets, becoming stronger dorsally; interior lirate, the lirae stronger near the margin; ctenolium present; cardinal crura well developed, cross striated.

This is a very interesting species which retains the outline of *Chlamys* while at times it assumes the characters of *Amusium*.

Some specimens are almost ribless, except on the umbones, and in this state the species would belong to the "subgenus" *Lissopecten* Verill; in others the ribs are well developed and continuous down to the very margin, which they then crenulate; in which state the shell is a typical *Chlamys*. In most of its shell characters it is intermediate between the two subgenera, *Chlamys* and *Amusium*. Just over the line, and separated from the present species more by its outline than by any other important character, is the shell I have called *Amusium ocalanum*, all of which, with the aid of *A. lyoni* Gabb, form a complete connecting series between the most typical *Amusium* and undoubted *Chlamys*.

Shell of medium size, moderately thick, extremely inequilateral. Valves slightly elongated, moderately and nearly equally convex. Beaks pointed. Ribs 18 or 22, low, rounded, simple; on most specimens tend to become more distant with growth. On adults the interspaces usually are as wide as the ribs. On young shells the ribs are more closely spaced and more elevated. Shells scalloped marginally and concentrically sculptured by fine growth lines. On a number of adults is a single radial thread in the interspaces over the central part of the disk. Submargins narrow, without radial sculpture. Auricles angular, subequal. One left valves the auricles rarely are radially threaded but are strongly corrugated. One left valve has five radiating rows of small elevated scales. Byssal auricle usually has five well developed radials. Right posterior auricle has no radial sculpture, but is corrugated. Byssal sinus deep, fasciole conspicuous.

Internal ribs match the external in number and become markedly bicarinate at the margins of the valves. Ctenolium becomes obsolete or nearly so on adult specimens. Auricular crura feebly developed. Chondrophore shallow.

Description is based upon 46 specimens from Ocala, Fla. Those from the type locality show much variation in strength and obliquity of ribs and degree. In some they are fairly strong, low and rounded ribs; in others they are almost obsolete; on one they are fairly strong umbonally but disappear peripherally. Ctenolium has three to four denticles. Byssal auricle strongly threaded. Some left auricles show three or four obsolete ribs. Holotype lacks a provinculum. Valves ribbed internally, resembling *Amusium*.

Specimens from Alachua County and Martin's Station closely resemble those from Ocala, Florida.

Remarks.—*C. indecisus* differs from *C. ocalanus* in its distinct byssal sinus, well defined radial sculpture, smaller size and more inequilateral shape. It is distinguished from other described Eocene species from the Atlantic Coast by size, sculpture and markedly inequilateral valves.

Dimensions.—Holotype, height 17, width 14.5 mm. Hypotypes: Right, height 29, width 26 mm.; left, height 28, width 24 mm.

Localities.—Archer, Alachua County, Fla. (type), [Dall]; Martin's Station; Artesian Well, Ponce de Leon Hotel, St. Augustine; Tampa limesone of the Hillsboro River, near Tampa, Fla., [Dall and Wilcox]; Red Bluff, seven miles above Bainbridge, Ga., [Cooke]; Ocala, Fla.

Horizons.—Jackson (Eocene); Vicksburg (Oligocene), Tampa (Miocene).

Hypotypes.—Collection H. I. Rowland.

Holotype.—U. S. National Museum, Cat. No. 107754.

Chlamys (Chlamys) anatipes (Morton)

Pl. 7, Fig. 2; Pl. 10, Fig. 13.

Pecten anatipes Morton, Am. Jour. Sci., **23**:293, 1833; Morton, Syn. Org. Rem.; 58, pl. 5, fig. 4, 1834; Morton, Acad., Nat. Sci. Phila., Proc., **1**:217, 1842; Conrad, Am. Jour. Conch., **1**:14, 1865; Heilprin, Acad. Nat. Sci. Phila., Proc., **33**:417, 1881; de Gregorio, Ann. de Geol. et Pal., **7** et **8** liv.: 181, pl. 21, fig. 29, 1890; Cooke, Ala. Geol. Surv., Rept. **14**: pl. 97, figs. 1a, 1b, 1926.

Pecten (Nodipecten) anatipes Morton; Dall, Wagner Free Inst. Sci., Trans., **3**:30, 1898.

Pecten (Chlamys) anatipes Morton; Dall, U. S. Nat. Mus., Proc., **51**:492, pl. 84, fig. 9, 191.

Description.—Morton's original description:

With four or five broad convex ribs, longitudinally striated; at the sides large striae replace the ribs. Rarely more than half an inch in diameter. From the overlying limestones of Claiborne, Alabama.

Shells from Heidelberg, Miss., (U. S. National Museum, Cat. No. 137823), have three strong, rounded ribs on the central portion of the disk, with a smaller one on either side. Summits and sides of the ribs radially threaded. Interspaces threaded near the ventral margin; with concentric lines of growth except at the margins. Submargins narrow, radially threaded. Internal fluting reflects external radial sculpture. Cardinal crura strong. Some valves which are slightly nodose possibly should be referred to *Lyropecten*.

The holotype, a fragment, has four well elevated, rounded ribs which carry numerous, slightly scabrous radial threads. Interspaces rounded, without ornamentation. Sub-margins probably had only sculpture of slightly coarser radials Ribs become narrower and more closely spaced toward the beak, and seem to lose their radial threads.

Dimensions.—Holotype, height 12, width 11 mm.

Localities.—St. Stephen's, Ala. (type), [Morton]; Heidelberg, and Jasper County, Miss., [Aldrich, Burns, Johnson]; Red Bluff, seven miles above Bainbridge, Decatur County; on west bank of Flint River, opposite Liittle Horseshoe Point, 0.5 mile below Mascot Point and 4.5 mi. below Bainbridge, Ga., [Vaughan, Cooke, Mansfield].

Horizon.—Vicksburg (Oliocene).

Hypotypes.—U. S. National Museum, Cat. No. 137823.

Holotype.—Academy of Natural Sciences of Philadelphia, Cat. No. 12575.

Chlamys (Chlamys) tricenarius (Conrad)

Pl. 10, Fig. 3.

Pecten tricenarius Conrad, Acad. Nat. Sci. Phila., Proc., **1**:306, 1843; Conrad, Foss. Med. Tertiary Form.: 74, pl. 42, fig. 2, Jan., 1845; Conrad, Acad. Nat. Sci. Phila., Proc., **14**:582, 1862; Heilprin, Acad. Nat. Sci. Phila., Proc., **33**:420, 1881.

Pecten (Chlamys) tricenarius Conrad; Dall, Wagner Free Inst. Sci., Trans., **3**:740, 1898.

Description.—Conrad's original description:

Suborbicular; inferior valve convex, ribs thirty to thirty-three, somewhat unequal in size, crossed by minute lines; sinus of the ear profound.

Holotype is orbicular, quite convex, translucent. Six obscure, widely spaced, radial threads appear in the umbonal area. About 9 mm. from the beak the ribs begin to increase by intercalation (rarely by dichotomy), numbering 30 at the ventral margin. Ribs broadly rounded, about half the width of interspaces. Concentric lines form scales at their intersectiion with the ribs, becoming more conspicuous at the ventral margin. Submargins narrow, without radial sculptures; they have obscure camptonectes marking. Right posterior auricle finely and evenly threaded with six scabrous radials. Right anterior byssal auricle has four coarser radial threaads; fasciole wide; notch broad; byssal auricle 2 mm. the longer. Ctenolium doubtful; shell faintly ribbed internally.

Remarks.—This species is smaller, and has larger auricles than *C. perplanus*. Only the holotype is known.

Dimensions.—Holotype, height 20, width 20, hinge 11, convexity 3.5 mm.

Locality.—Pamunkey River, Va., [Conrad].

Horizon.—Miocene?

Holotype.—Academy of Natural Sciences of Philadelphia, Cat. No. 12578.

Chlamys (Chlamys) trentensis (Harris)

Pl. 10, Fig. 8.

Pecten trentensis Harris, Bull. Am. Pal., 8:15, pl. 2, figs. 8, 9, 1919; Kellum, U. S. Geol. Surv., Prof. Paper **143**:35, 1926.

Description.—Harris' original description:

Form and size as indicated by the illustrations; ribs highly variable in number, size and amount of ornamentation; generally bifid and generally ornamented by highly raised, scale-like or imbricating concentric lines; costation showing a strong tendency towards a tri- or quinque-costate pattern, especially in the left valve; central rib largest of three or five major ones.

Shell elongate, somewhat convex with 12 to 15 more or less well developed ribs. Right anterior byssal auricle the longer; byssal notch conspicuous; ctenolium present, Auricles of right and left valaves ornamented with seven to twelve radials. Margins of valves fluted internally.

Dimensions.—Holotype, height 29, width 26 mm.

Locality.—Light marly bed, right bank of Trent River near water's edge, about 6 mi. below Polloksville, N. C., [Harris].

Horizon.—Trent (Miocene).

Holotype.—Paleontological Research Institution.

Chlamys (Chlamys) crocus (Cooke)
Pl. 6, Figs. 9, 11.

Pecten crocus Cooke, Carnegie Inst. Wash., Publ. **291**:135, pl. 9, figs. 2a, b; pl. 11, fig. 9; 1919.

Chlamys (Chlamys) crocus Cooke; Tucker, Amer. Midl. Nat., **15**:(**5**):614, pl. 25, fig. 3, 1934.

Description.—Cooke's original description:

Shell equivalve, inequilateral, moderately convex; about 22 round ribs, separated by slightly narrower interspaces; surface of the ribs with curved imbricating spines, convex toward the umbones, and with very faint radiating striae; interspaces with sculpture of fine, close-set, concentric striae: near the ventral margin a small thread appears in each interspace; submargins depressed, ornamented with small radial threads and fine concentric striae; ears moderately large, subequal, with radial, nodose riblets.

Florida shells are lower in proportion to their width than are the Anguilla specimens. In them, intercostal is nearly as wide as the interspaces. Spiny sculpture well developed on the central part of the disk near the ventral margin and on the anterior and posterior portions of the valves. Auricles somewhat larger than those of the holotype, unequal; sculpture scabrous and finely radial sculpture. Fasciole distinct; byssal notch shallow. Ctenolium of about three denticles. Internal margin grooved. These differences probably are within the normal range of variation.

Dimensions.—Hypotypes: Right valve, height 36, width 30 mm.; left valve, height 28.5, width 22.5 mm.

Localities.—Crocus Bay, Anguilla (type), [Cooke]; Six Mile Creek, Fla., [Tucker].

Horizon.—Tampa (Miocene).

Hypotypes.—Collection H. I. Rowland.

Holotype.—U. S. National Museum, Cat. No. 167079.

Chlamys (Chlamys) chipolanus (Dall)
Pl. 7, Fig. 4; Pl. 9, Fig. 3.

Pecten (Aequipecten) chipolanus Dall, Wagner Free Inst. Sci., Trans., **3**:[illegible], pl. 29, fig. 9, 1898.

Chlamys (Chlamys) chipolanus Dall; Gardner, U. S. Geol. Surv., Prof. Paper, **142-A**:47, pl. 12, fig. 2, 1926.

Description.—Dall's original description:

Shell solid, rounded, plump, with fifteen to seventeen strong rounded ribs with narrower interspaces which are almost channeled, both ribs and channels with continuous fluctuated, sometimes crowded, low concentric lamellae; the ribs faintly grooved distally on top; the concentric sculpture sometimes strong on three or more ribs and almost absent on the intervening ones; hinge-line wide, ears large, with conspicuous but not deep notch, with six or seven coarsely imbricated, close set radiial threads on the byssal ear and more numerous threads on the others; subragins nearly smooth; cardinal crura strong; inner basal margin with strong, short flutings, obsolete above.

Gardner says:

Chlamys chipolanus offers perhaps a wider range of variation than any other of the Alum Bluff Pectens. . . It is rather surprising that much the most common species of the Chipola should be of so early a type.

Specimens from the type locality commonly have a single thread in the interspaces near the margins, and develop a thread on the summits of the ribs. Ctenolium of three to five denticles present; provinculum retained. Auricles of young valves appear larger in proportion to the size of the shell than do those of adults.

Remarks.—The right valve of *C. chipolanus* is less convex than that of *C. burnsi,* and the left valve is nearly flat. The sculpture of *chipolanus* is more sharply defined than that of *C. alumensis.*

Dimensions.—Holotype, height 25, width 25, hinge 18 mm. Hypotype, height 21, width 18 mm.

Localities.—Chipola River (type); Alum Bluff; Ballast Point, Fla., [Dall and Burns].

Horizon.—Tampa, and Chipola (Miocene).

Hypotype.—U. S. National Museum, Cat. No. 114784.

Holotype.—U. S. National Museum, Cat. No. 11784.

Chlamys (Chlamys) alumensis (Dall)

Pl. 7, Figs. 1, 3.

Pecten (Chlamys) alumensis Dall, Wagner Free Inst. Sci., Trans., **3**:740, pl. 34, figs. 10-11, 1898.

Chlamys (Chlamys) alumensis Dall; Gardner, U. S. Geol. Surv., Prof. Paper, **142-A**:47, pl. 12, figs. 8, 9, 1926.

Description.—Dall's original description:

Shell small, thin, with compressed, flattish umbones and fourteen or fifteen feeble, obsolete ribs on the lower part of the disk separated by equal shallow interspaces; the whole surface marked with fine concentric lines; ears sub-equal, concentrically striated, not radiated, except the byssal ear, which has five scabrous riblets and a well marked notch; interior fluted to correspond with the external ribs; the cardinal crura developed.

Auricles of the left valve show traces of radials near the beak. Submargins narrow, steep, unornamented. Byssal auricle has four strong radiating threads crossed by concentric lamellae. Elongated, wide, deep, conspicuous fasciole. Ctenolium present; strong cardinal crura. Ventral margin lirate internally.

Dimensions.—Syntypes: Right, height 8.5, width 8 mm.: left, height 8.5, width 8 mm.

Localities.—Alum Bluff, Calhoun County (type); Chattahoochee River, Fla., [Dall].

Horizon.—Chipola (Miocene).

Syntypes.—U. S. National Museum, Cat. No. 114580.

Chlamys (Chlamys) coccymelus (Dall)

Pl. 8, Figs. 3, 4.

Pecten (Chlamys) coccymelus Dall, Wagner Free Inst. Sci., Trans., **3**:741, pl. 34, fig. 1, 1898; Glenn, Md. Geol. Surv., *Miocene*: 374, pl. 99, fig. 3, 1904.

Description.—Dall's original original description:

Shell small, ovate, inflated, strongly sculptured, with unequal ears; disk with eighteen narrow, high, compressed ribs, with wider interspaces, which near the basal margin carry one or two very small radial threads; the backs of the ribs support

numerous high, evenly spaced, distally guttered, small spines; in the interspaces only transverse sculpture of wavy incremental lines; submargins small, narrow, with fine beaded radial threads, which in the left valve also extend over the ears; hinge-line short, the cardinal crura developed, sharply cross-striated; auricular crura present; interior of the disk fluted in harmony with the external ribs.

Ribs narrow, keeled, slightly wider at the base, with a single row of erect spines which are reflected toward the beak. There is a single row of spines in each interspace extending to the umbonal region. One, sometimes two, rows of poorly developed secondary spines appear in the interspaces near the ventral margin of the valve.

Young individuals of *C. madisonius* have quite as thin shells as *C. coccymelus* and pass through a stage in their development in which they present a strikingly similar appearance. *C. coccymelus* may be simply a case of arrested development.

Remarks.—Young valves of this species usually can be separated from the young shells of *C. madisonius* by their more oval outline and greater convexity.

Dimensions.—Holotype, height 30, width 25 mm. Hypotypes, height 26, width 22 mm.

Localities.—Plum Point, Md. (type), [Dall]; Chesapeake Beach, Md.

Horizon.—Calvert (Miocene).

Hypotype.—Collection H. I. Rowland.

Holotype.—U. S. National Museum, Cat. No. 87754.

Chlamys (Chlamys) rogersi (Conrad)

Pecten rogersi Conrad, Acad. Nat. Sci. Phila., Jour. **7**:151, 1834; Foss. Med. Tert.: 45, pl. 21, fig. 9, 1840; Acad. Nat. Sci. Phila., Proc. **14**:581, 1863; Meek, *Miocene Check List*, Smith. Misc. Coll.: 4, 1864; Heilprin, Acad. Nat. Sci. Phila., Proc., **33**:420, 1881.

Pecten (Nodipecten) rogersi Conrad; Dall, Wagner Free Inst. Sci., Trans. **3**:730, 1898, *partim.*

Pecten (Chlamys) rogersi Conrad; Glenn, Md. Geol. Surv., *Miocene*: 375, 1904, *partim.*

Description.—Conrad's original description:

Shell ovate, compressed; with four very large and broad convex ribs and numerous radiating lines; ears small.

Holotype is a right valve. Shell small, translucent; four broad almost flat-topped primary ribs, which at the ventral margin are nearly twice the width of the slightly rounded interspaces. Both ribs and interspaces marked by closely spaced, fine, scabrous threads. Marginally the scales become more prominent. Submargins narrow, steep, scabrous, without radials. Left auricle small, with fine, densely scaly radial threads. Right auricle lacking. Ctenolium of four fairly coarse denticles. Internally there are four broadly rounded ribs.

Dimensions.—Holotype, height 27, width 25 mm. Hypotype, height 10, width 7 mm.

Localities.—James River, near Smithfield, Va. (type), [Conrad]; Murfreesboro Landing on Meherrin River, N. C.

Horizons.—Choptank, and Yorktown (Miocene).

Holotype.—Academy of Natural Sciences of Philadelphia, Cat. No. 12581.

Chlamys (Chlamys) decemnarius (Conrad)

Pl. 8, Figs. 5, 6.

Pecten decemnarius Conrad, Acad. Nat. Sci. Phila., Jour., **7**:151, 1834; Foss. Med. Tert.: 49, pl. 24, fig. 2, 1840; Acad. Nat. Sci. Phila., Proc., **14**:581, 1863; Heilprin, Acad. Nat. Sci. Phila., Proc., **33**:418, 1881.

Pecten (Chlamys) decemnarius Conrad; Dall, Wagner Free Inst. Sci., Trans., **3**:741, 1898.

Description.—Conrad's original description:

Shell ovate, slightly convex, with about ten broad flattened ribs, disappearing on the umbo, some of them sulcated; radiating striae numerous, distinct, subscabrous; ears unequal.

The largest shell from the type locality in the Academy of Natural Sciences of Philadelphia is a left valve; 66 mm. high and 64 mm. width. In general, left valves retain well developed ribs from beak to margin. Sulci commonly appear on summits of the primary ribs on shells about 35 mm. in height. At a height 18 mm., the primary ribs have conspicuous, rather closely spaced, erect lamellae. Development of sulci on primary ribs is accompanied by appearance of secondary ribs and numerous fine threads in the interspaces. Ribs continue to the submargins. The concentric lamellae form minute, erect scales as they cross the threads. Submargins wide, with fine scabrous radials. Auricles subequal, threaded with coarse, scabrous radials.

Both valves translucent. Right valves commonly have only fine radial striae until they attain heights of 15-20 mm.; beyond which primary ribs appear and the valves develop as do left valves. They have two or three sulci on the summits of the primary ribs. Left auricle small; right the more coarsely threaded. Fasciole wide; notch deep and broad; ctenolium present. Shell internally ribbed.

Specimens from York River, Va. (U. S. National Museum), are thinner than those from the type locality and do not have the elevated concentric lamellae characteristic of the valves from other localities. Otherwise they are similar.

Left valves designed *Pecten dispalatus* by Conrad, from Pamunkey, Va., have three prominent ribs which become bi- or tri-partite as they approach the ventral margin of the shell. Intercostal cords extend to the umbonal

region and across the submargins. Concentric lamellae are less conspicuous than in typical forms.

Dimensions.—Hypotypes: Right, height 32, width 27 mm.; left, height 31, width 26 mm.

Localities.—City Point, Va. (type); Ruffin's Creek, James River and Pamunkey River, Va., [Conrad]; Coggin's Point, and York River, Va., [Burns]; Ashley River phosphate rock, S.C., [Dall].

Horizons.—St. Marys, and Yorktown (Miocene).

Hypotypes.—U. S. National Museum, Cat. No. 6361.

Syntypes.—Collection Academy of Natural Sciences of Philadelphia.

Chlamys (Chlamys) harrisi (Dall)

Pl. 8, Fig. 9.

Pecten (Chlamys) harrisi Dall, Wagner Free Inst. Sci., Trans., **3**:742, pl. 34, fig. 24, 1898.

Description.—Dall's original description:

Shell strong, rounded, with seventeen coarse, rounded ribs with narrower interspaces, overrun by close-set, prominent, slightly wavy, strong, concentric lamellation; near the basal margin the ribs and interspaces are marked with a few sharp radial striae; submargins and ears with smaller radial threads similarly lamellose; notch narrow, deep; ctenolium present, short; interior of disk strongly fluted, lirate; cardinal crura strong, auricular crura feeble.

A single adult valve anad numerous immature ones were obtained.

The valve figured is a little irregular. The younger shells are proportionately flatter and with wider ears. They have, as often observed in the young of *P. exasperatus*, in some cases three or four of the ribs more prominent than the rest, and the lamellation worn off from the tops of the ribs or incomplete there.

Dimensions.—Holotype, height 31, width 31, semidiameter 7 mm.

Locality.—Caloosahatchie River, Fla. (type), [Dall, Wilcox].

Horizon.—Caloosahatchie (Pliocene).

Holotype.—U. S. National Museum, Cat. No. 154485.

Chlamys (Chlamys) exasperatus (Sowerby)

Pl. 8, Figs. 1, 2, 11.

Pecten exasperatus Sowerby, Thesaur. Conch., **1**:54, pl. 18, figs. 183-85, 1843; Reeve, Conch. Icon., *Pecten*: pl. 12, figs. 8, 8a, 8b, 1852; Sowerby, 1886, Geol. Soc. London, Proc. **22**:294, 1886; Dall, U. S. Nat. Mus. Bull. **37**:34, 1889.

Pecten fuscopurpureus Conrad, Acad. Nat. Sci. Phila., Jour., N. S., **1**:209, 280, pl. 39, fig. 10, 1849.

Pecten triradiatus Reeve, Conch. Icon., *Pecten*: pl. 28, fig. 120, (not of Müller, Zool. Dan. Prodr. p. 25, 1776).

Pecten cretatus Reeve, Conch. Icon., *Pecten*: pl. 29, figs. 129a, 129b, 1852.

Pecten (Chlamys) exasperatus Sowerby; Dall, Wagner Free Inst. Sci., Trans., **3**:742, 1898.

Description.—Sowerby's original description:

T. rotundata, sub-quadrata, sub-ventricosa, scabra: auriculis magni, scabrosa-striatis; costis octodecim, subangulatis, angulis lateribus serratim striatis, color vario.

Shell thin, moderately convex, usually with 17 ribs and radially sculptured with fine scabrous threads. Auricles unequal, with radial sculpture of fine scaly threaads which are markedly stronger on the byssal auricle. Fasciole conspicuous. Ctenolium of four to six denticles. All specimens have microscopic provincula.

Young shells are more rotund and convex than adults, with auricles proportionately more conspicuous. They lack intercostals and have camptonectes marking in the flat interspaces. It varies among individuals from Sanibel Island, Fla.; it appears to be rare on adult valves and more common on recent than on fossil shells. Usually it occurs only on the submargins, but appears in the interspaces of some adults. Most adults have one or several scabrous intercostals. Fasciole wide; notch narrow; shell internally lirate.

Recent shells range brown, white, pink and yellow to shades of red; and are unicolored or mottled.

Dimensions.—Hypotypes: Right valve, height 18, width 14 mm.; left valve, height 16, width 12 mm.; (Ft. Denaud, Fla.); right valve, height 38, width 28 mm, (Port Mayaca, Fla.).

Localities.—Costa Rica, [Gabb]; Shell Creek, Fla., [Willcox]; Simmons Bluff, S. C., and Antilles, [Dall]; living from Cape Hatteras, N. D. to Guadelupe Island, W.I., and on Gulf coast of Florida, [Dall]; Sanibel Island, Moore Haven, Ft. Denaud, Prairie Creek, Port Mayaca, and Acline, Fla.

Horizon.—Pliocene to Recent.

Hypotypes.—Collection H. I. Rowland.

Syntypes.—Collection British Museum of Natural History.

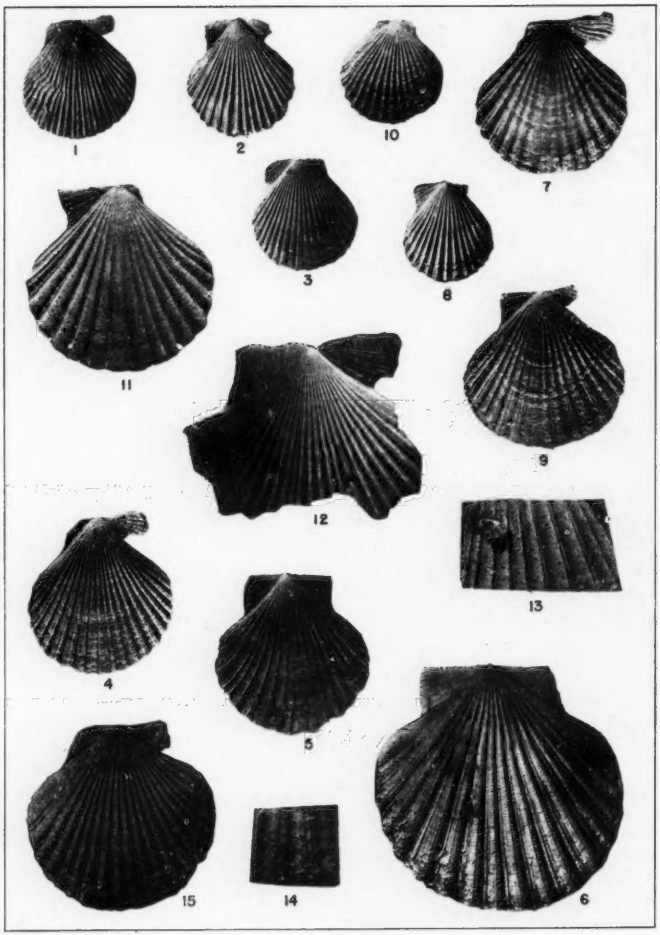


Fig. (1.) *Chlamys (Chlamys) clarkeanus* (Aldrich). 200 yds. below mouth of Negreet Bayou, La. Hypotype; (2.)*dehayesi* (Lea). Claiborne, Ala. (Claiborne) Hypotype; (3.) *deyaesi* (Lea). Claiborne, Ala. (Claiborne). Hypotype; (4.) *dehayesi* (Lea); Claiborne, Ala. (Hypotype). Hypotype; (5.) *dehayesi* (Lea). Claiborne, Ala. (Claiborne). Hypotype; (6.) *dehayesi dennisoni* Tucker. Claiborne, Ala. (Claiborne). Holotype; (7.) *wautubbeans* Dall. Wautubbee, Miss. Hypotype; (8, 9.) *wautubbeanus* Dall. Hickory, Miss. Hypotype; (10.) *wautubbeanus willcoxi* (Dall). Sabine River, Texas. Hypotype; (11.) *cainei* (Harris). *Wautubbee*, Miss. Holotype; (12.) *cacawensis* (Harris). Orangeburg, S. C. Gutta percha squeeze of umbonal region of a syntype; (13.) *cacawensis* (Harris). Orangeburg, S. C. Portion of a right valve (syntype) showing surface sculpture. (14.) *cacawensis* (Harris). Orangeburg, S. C. Syntype, showing sculpture of left valve. (15.) *cacawensis* (Harris). Claiborne, Ala. (Claiborne). Hypotype. (All figures x 0.6.)

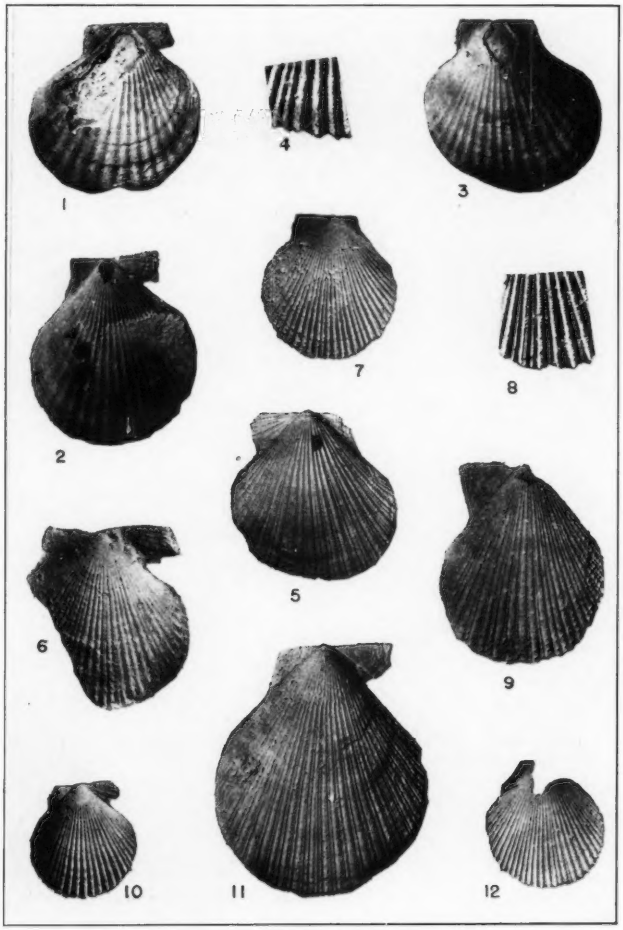
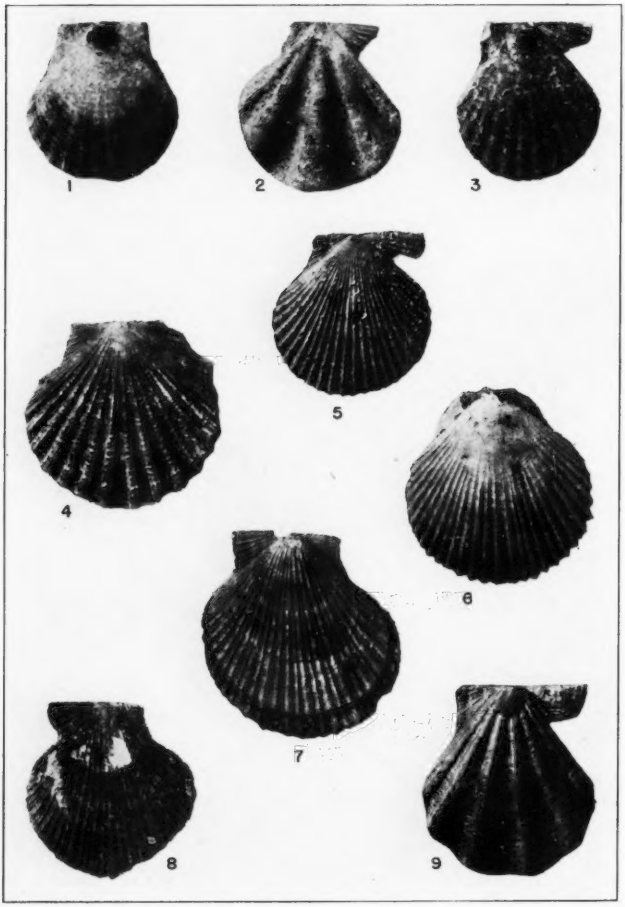


Fig. (1, 3.) *Chlamys (Chlamys) indecisus* Dall. Ocala, Fla. (Ocala). Hypotypes; (2.) *indecisus* Dall. Archer Alachua County, Fla. (Ocala). Holotype; (4.) *dansvillensis* Weisbord, sp. nov. Enlarged to show detail of sculpture; (5.) *sheldonae* Tucker. Ft. Washington, Md. (Aquia) Holotype; (6.) *dansvillensis* Weisbord, sp. nov. Dansville Landing, La. (Jackson) Syntype; (7). *choctavensis* (Aldrich). Woods Bluff, Ala. Hypotype; (8.) *sheldonae* Tucker, Detail of sculpture of holotype; (9, 11.) *crocus* (Cooke). Six Mile Creek, Fla. (Tampa) Hypotypes; (10.) *greggi* Harris. Yellow Bluff, Ala. Hypotype; (12.) *dansvillensis* Weisbord, sp. nov. Dansville Landing, La. (Jackson) Syntype.



Figs. (1, 3.) *Chlamys (Chlamys) alumensis* Dall. Alum Bluff, Calhoun County, Fla. (Alum Bluff) Syntypes; (2.) *anatipes* (Morton). Heidelberg, Miss. (Vicksburg) Hypotype; (4.) *chipolanus* Dall. Chipola River, Fla. (Chipola) Hypotype; (5.) *cookei* (Kellum). Magnolia, N.C. (Castle Hayne) Holotype; (6.) *clarkeanus* (Aldrich). Black Bluff Shoals, Brazos River, Texas. Hypotype; (7.) *cocoanus* Dall. Cocoa Post-office, Ala. Holotype; (8) *cocoanus* Dall. Cocoa Post-office, Ala. Hypotype; (9). *rogersi* (Conrad). Skipton, Md. Hypotype.

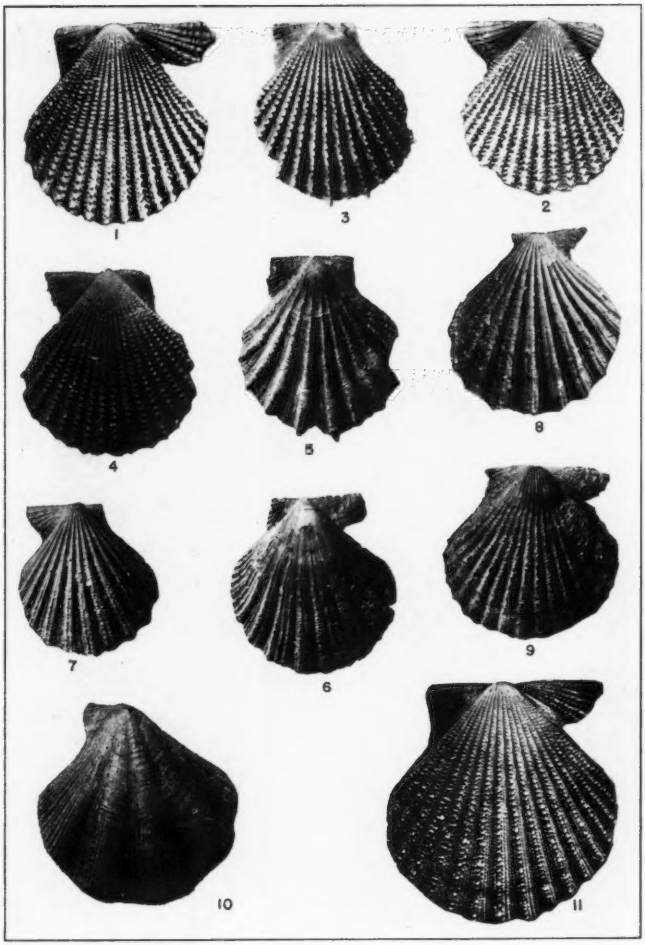
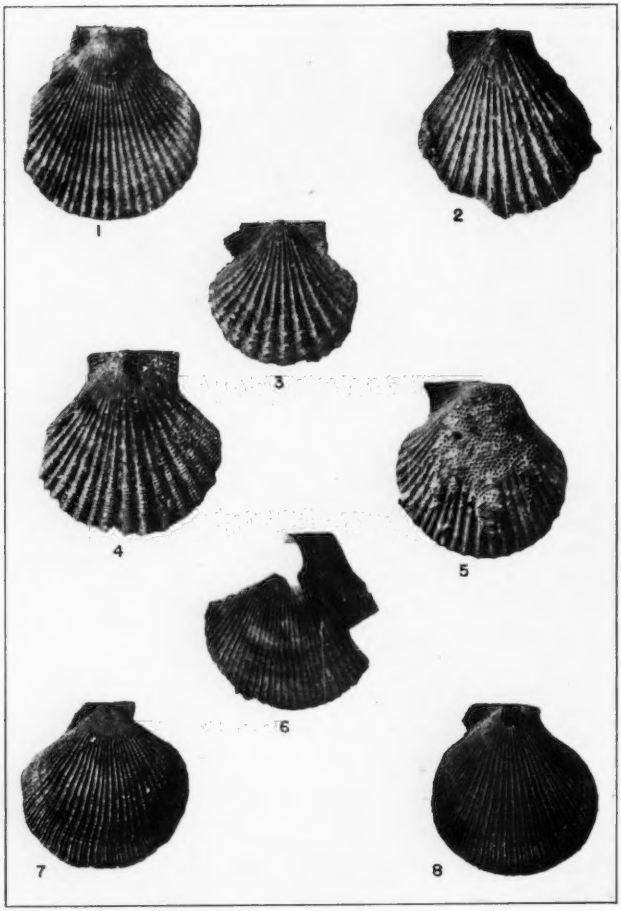


Fig. (1, 2). *Chlamys (Chlamys) exasperatus* (Sowerby). Ft. Denaud, Fla. (Caloosahatchie). Hypotypes; (3.) *coccymelus* Dall. Plum Point, Md. (Calvert) Holotype; (4.) *coccymelus* Dall. Plum Point, Md. (Calvert) Hyptype; (5, 6.) *decemnarius* (Conrad). City Point, Va. Hypotypes; (7.) *beverlyi* Tucker. Lisbon, Ala. Hypotype; (8.) *beverlyi* Tucker. Lisbon, Ala. Holotype; (9) *harrisi* Dall. Caloosahatchie River, Fla. (Caloosahatchie) Holotype; (10.) *rogersi* (Conrad). James River, near Smithfield, Va. Holotype; 11. *exasperatus* (Sowerby). Port Mayaca, Fla. (Caloosahatchie) Hypotype.



Figs. (1.) *Chlamys (Chlamys) cushmani* (Kellum). 3 mi. east of Quinerly, N. C. (Castle Hayne) Holotype; (2.) biddleanus (Kellum). Biddle Landing, N. C. (Castle Hayne) Holotype; (3.) *chipolanus* (Dall). Chipola River, Fla. (Chipola) Holotype; (4.) *wautubbeanus* Dall. Wautubbee, near Newton, Miss. Holotype; (5.) *cookei* (Kellum). Magnolia, N. C. (Castle Hayne) Hypotype; (6.) *choctavensis* (Aldrich). Choctaw Corners, Ala. Holotype; (7, 8.) *membranosus* (Morton). Wilmington, N. C. (Castle Hayne) Hypotypes.

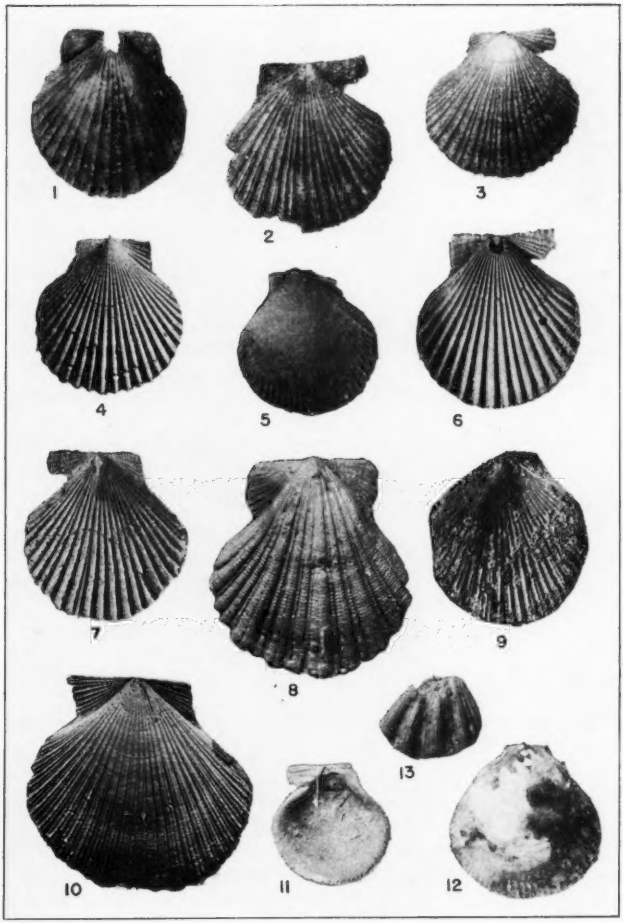


Fig. (1.) *Chlamys (Chlamys) johnsoni* (Clark). Potomac Creek, Va. Holotype; (2.) *wautbbeanus willcoxi* (Dall). Clark County, Miss. Holotype; (3.) *tricenarius* (Conrad). Pamunkey River, Va. Holotype; (4.) *greggi* Harris. Greggs Landing, Ala. (Wilcox) Hypotype; (5.) *clarkeanus* (Aldrich). Brazos River, Texas. Hypotype; (6.) *nuperus* (Conrad). Jackson, Miss. Hypotype; (7.) *rigbyi* (Whiitfield). Shark River, N. J. Holotype; (8.) *trentensis* (Harris). Polloksville, N. C. (Trent) Holotype; (9.) *kneiskerni* (Conrad). Shark River, N. J. Holotype; (10.) *dehayesi tirmus* (de Gregorio). Claiborne, Ala. (Claiborne) Hypotype; (11.) *membranosus* (Morton). "Calcareous strata of South Carolina." *Holotype;* (12.) *clarkeanus* (Aldrich). Black Bluff Shoals, Brazos River, Texas. Hypotype; (13.) *anatipes* (Morton). St. Stephens, Ala. Holotype.

The Occurrence of Cedrela in the Miocene of Western America

Chester A. Arnold

The genus *Cedrela* (family Meliaceae) at present occurs in Mexico, Central and South America, and the West Indies. *C. mexicana,* the so-called Mexican cedar, is used in the manufacture of cigar boxes. A closely related genus, *Toonia,* is native in eastern Asia.

The presence of *Cedrela* in the Latah formation (Miocene) at Spokane, Washington, was recently demonstrated when it was shown that certain fossil seeds previously referred to *Gordonia* belong to the former genus (Brown, 1935). More recently, the seeds of *Cedrela* have been found in abundance at several localities in the lacustrine deposits along Succor Creek, Malheur County, Oregon. Intimately associated with these seeds are detached leaflets and a few capsules.

The leaves of *Cedrela* are pinnately compound and bear some resemblance to those of *Ailanthus* or *Juglans*. The leaflets vary in shape from ovate to lanceolate, and the midrib is frequently arched upward thereby deflecting the tips slightly backward. Consequently the leaflets are somewhat curved and quite oblique since the basal portion of the lamina is broader above the midrib. However, there is considerable variation with respect to these features. Many of the leaflets are symmetrical and straight. On the other hand, many of the fossil leaflets show the more pronounced asymmetry and curvature, and it is from these that the more positive generic identifications can be made. The primary veins depart from the midrib at an obtuse angle and curve upward gradually toward the margin. The margin is smooth or shallowly undulate in the common species.

More than thirty leaflets collected from three localities in the vicinity of Succor Creek are referable to *Cedrela*. Among these, two species are recognizable, and are described below.

Cedrela Trainii sp. nov.

Figs. 1 and 2.

Leaflets lanceolate and tapering; up to 15 cm. in length, 2 to 2.5 cm. broad; margin shallowly undulate; midrib curved but straightening somewhat as apex is approached; stalk 8 mm. long; primary lateral veins 3 to 8 mm. apart, departing from the midrib at an obtuse angle and bending upward gradually as the margin is approached; base decidedly asymmetrical, upper margin broader than the lower but forming an acute or nearly acute angle to the midrib.

Occurrence: Strode ranch, Succor Creek; and McKenzie ranch, Carter Creek, Malheur County, Oregon.

Type: Nos. 17751 & 17752. Univ. of Michigan Collection.

This species is named after Mr. Percy Train who collected the material.

Cedrela Browniana sp. nov.

Fig. 11.

Leaflets ovate-lanceolate; up to 17 cm. long and 4.5 cm. broad; primary veins 8 to 15 mm. apart; base decidedly asymmetrical with the upper margin full and rounded, lower maragin acute; otherwise similar to *C. Trainii.*

Occurrence: with *C. Trainii.*

Type: No. 17750, Univ. of Michigan Collection.

This species is named after Dr. R. W. Brown of the United States Geological Survey.

The leaflets of the two species differ in size and somewhat in shape. Those of *C. Trainii* are smaller, more slender, and more tapering. Those of *C. Browniana* are larger and broader in proportion to their length.

Comparison of the living and fossil forms of *Cedrela* is difficult to accomplish because of the variations exhibited by the large pinnately compound leaves. The fossil foliage is represented only by the detached leaflets so the size and shape of the complete leaves can be conjectured only from them. Except for being longer, *C. Browniana* resembles *C. mexicana.* The leaflets of *C. fissilis* from Paraguay show the same type of asymmetrical leaflet base with the greatly rounded and full upper margin. *C. Trainii* is more unlike the living species by showing leaflets which are slender and tapering. Some living species, as *C. Huberi,* have rather slender leaflets which taper more abruptly beyond the middle than do the fossil types. This species also shows a less curved midrib.

References in the literature to fossil material of *Cedrela* are uncommon. Brief mention is made of its occurrence in the Miocene of Europe. Berry (1916) described four species from the lower Eocene of Tennessee and Mississippi, of which only one, *C. odoratifolia,* shows any resemblance to the Oregon material. It is comparable in size with *C. Trainii* but differs by being less oblique.

The seeds of *Cedrela* constitute one of the common plant types in the Succor Creek plant bearing formation. About two hundred specimens have been recovered. They show considerable variation in size and shape but are seldom more than 25 mm. in length. On most of them the lower margin is rounded (Figs. 5 & 8) but some show the spinous extension (Fig. 4). Others are intermediate between these extremes (Figs. 6, 7, 9 & 10). Numerous aborted seeds occur in which the wing is fully developed but with the embryo portion small and thin. Similar aborted seeds are of common occurrence in the capsules of *C. mexicana.*

While two species are in evidence among the foliage remains no specific separation among the seeds has yet been possible. One might be inclined to attempt separation on the basis of the shape and relative extent of wing and seed portions and on the presence or absence of the inferior spinous extension were it not for the fact that within a single capsule of *C. mexicana* as great a degree of variation exists as among the whole assemblage of fossil specimens. Most of the seeds are slightly smaller than those figured from the Latah formation under the name of *C. pteraformis.* The latter are quite like the seeds of *C. mexicana* which are from 2 to 3 cm in length. This slight

difference is probably of no great significance and might reflect different environmental conditions under which the plants grew.

Associated with the leaves and seeds of *Cedrela* are a few objects recognizable as capsules (Fig. 3). These are oval structtures about 25 mm. long which show three valves separated by longitudinal sutures on the exposed surfaces of the specimens. Presumably there were five as in the living species. The scars of the perianth segments are visible on the pedicel just below the capsule.

Among living species of *Cedrela, C. mexicana,* from northern Mexico, probably ranges nearest the region in which the genus occurs in the fossil state, but it is probably not the modern representative of any of the fossil species. The differences between them in size and form of the leaflets show that the Miocene species, while much like modern species in many respects, must have been distinct. The leaflets of *C. Trainii* are more slender and tapering than those of *C. mexicana* and those of *C. Browniana* are distinctly larger. Then, the capsules and seeds are smaller. However, the differences are no greater than what could be expected between species and the fact that the foliage and fruits of *Cedrela* can be recognized as constituents of the Miocene flora of the northern part of the Great Basin region is of greater significance than matters involving specific relations. The occurence of the genus in two rather distant localities suggests a distribution over a considerable area during Miocene times, and its abundance at Succor Creek implies that it was one of the common plant types during the interval of deposition in that vicinity. Also, *Cedrela* is another example of a genus which, although at present limited to Mexico, Central anda South America, and the west Indies, once had a much wider distribution and probably existed under a greater variety of climatic conditions than at present.

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ANN ARBOR, MICHIGAN.

REFERENCES

BERRY, E. W. 1916—The lower Eocene floras of Southeastern United States. U. S. Geol. Surv. Prof. Pap. **91**.

BROWN, R. W. 1935—Miocene leaves, fruits, and seeds from Idaho, Oregon and Washington. Jour. Paleont. **9**(7):572-587.

EXPLANATION OF FIGURES

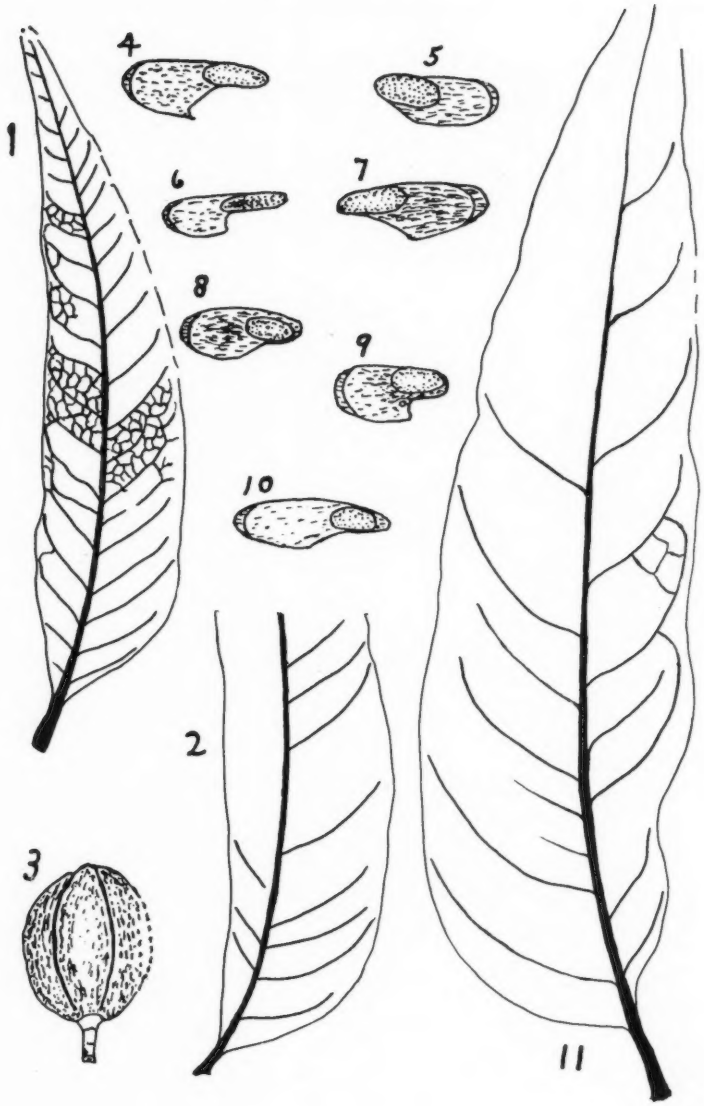
All figures were traced from photographs and are reproduced natural size.

FIGURE

1. *Cedrela Trainii* sp. nov. Holotype. No. 17752, Univ. of Mich. Coll.
2. *C. Trainii* sp. nov. Paratype. N. 17751, Univ. of Mich. Coll.
3. Capsule of *Cedrela* sp. showing three of the five valves and two sutures. No. 17749, Univ. of Mich. Coll.

4–10. Seeds of *Cedrela* sp. The range of variation in size and shape of the wing and seed portions is shown. Nos. 17753-17759, Univ. of Mich. Coll.

11. *Cedrela Browniana* sp. nov. Holotype. No. 17750, Univ. of Mich. Coll.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Book Reviews

REGIONAL GEOTECTONICS, by D. I. Mushketoff. Octavo, 528 pp., 108 maps and profiles in text. Leningrad and Moscow, 1935. In Russian. 6 rubles 50 cop. Binding 1 ruble 50 cop extra.

The general character of this book and its intended value in Russia are given in the following introductory note belonging probably to the publishers of this book:

"*Regional Geotectonics* by Professor Dmitri Ivanovich Mushketoff contains a short critical review of the recent geotectonical ideas and comparative description of geological structure and geotectonics of the most important areas of the world.

The book is illustrated with geotectonical maps and sections.

The great experience of the author in the field of geotectonical explorations and the use of a great amount of recent world literature dealing with geotectonics make the book particularly important for geologists-prospectors, especially young ones who may not be strong enough in the knowledge of foreign languages."

Mushketoff has collected an amazing amount of literature although he explains that he was unable to use all dealing with the subject of his book. He paid greatest attention to literature dealing with Europe as the best studied area of the world; least to that of his own country because (1) Russian literature is easily available to all Russian geologists; (2) "Geology of the USSR" is now in preparation, and in it all literature on Russian geology will be reviewed in full. Such omission of a part of the Russian literature, no matter how unfortunate for the reader, does not affect the description of the geotectonics of Russia, which is worked out exhaustively. As in all Russian scientific books published recently, emphasis is laid on the literature of the last score of years. Reference to literature in general is unsatisfactory, in most cases only the names of authors are mentioned; a reader checking some statement often will be forced to look through the whole book of an author to find the quoted passage. In some cases he even must decide to which paper reference is made, since some authors have several works mentioned in the list of literature at the end of the book, while others having their names in the text, are not mentioned in that list. The book thus gives the impression of having been written hastily and often very sketchily; much of the text suggests those notes which every scientist makes for his own use when reading. In many cases the reviewer would like to see more elaborate discussion, even though this would increase the size of the book considerably, which, perhaps, was impossible for the author. A few passages can be understood only by guessing, because words or even lines were dropped probably during printing. Though two editors are mentioned (one general and another technical), neither did his work well.

The author's relation toward different theories and hypotheses is not always clear. In some places he assembles serious objections to a certain hypothesis, yet in others he refers to that same hypothesis for the explanation of phenomena. The author has striven to remain objective, but in many cases the reviewer would welcome more subjective treatment of the subject. Mushketoff's great personal experiences in all geotectonic problems, his possession of materials which passed through his hands during his directorship of the Russian Geological Committee, part of which perhaps never was published, make such a subjective approach desirable. This cannot be considered a text book and every reader will be anxious to become familiar with the author's ideas in more detail. Inclusion of such material would have increased the volume of the book but it would, at the same time, have made its scientific value greater. The reviewer does not share the editors' opinion that the book is especially important for young geologists or prospectors, because it requires a serious geological and geographical background and hardly can be digested by beginners, even those having elementary geological training.

Like most of the recent Russian scientific books, this one is published on a poor grade of paper, which hardly will last for a reasonable length of time. It has adversely

affected the maps and profiles drawn by the author from varied Russian and foreign sources.

It is impossible in a short review to give an adequate idea of the rich content of Mushketoff's book. The reviewer limits, therefore, himself to a translation of the contents:

I. P. TOLMACHOFF,
CARNEGIE MUSEUM,
PITTSBURGH, PA.

PROCEDURE IN TAXONOMY, by Edward T. Schenk and John H. McMasters. Stanford University Press, 1936. vii + 72 pp. $2.00.

Pages 1-26 of this book are devoted to such topics as systematic categories, types, procedure in description, specific names, synonymy, disposition and storage of types, and Latin terms and abbreviations. Pages 27-56 contain the international rules of zoological nomenclature and summaries of opinions rendered under them. The sixteen page index deals in detail with new material, rules and opinions.

The authors recommend limitation of taxonomic categories to fifteen, though they do so only "for most systematic work." Presumably they will allow a larger number to taxonomists concerned with details of phylogeny or zoography, for whom subgentes, races and ecads may assume more importance than superfamilies or suborders. They are wholly justified in their criticism that many terms have been used without uniformity, and that some have been proposed without definition. If taxonomists wish more categories than those recommended by Schenk and McMasters, they at least should be consistent and accurate in usage.

The order of material in descriptions recommended on page 10 is open to criticism because it separates widely such closely related items as holotype number and location of types, or geologic age and locality. It also is more complex in its divisions than most taxonomic work demands.

The section on formation of specific names might have been enlarged with suggestions as to gender, endings, etc. Without them, the taxonomist should consult S. A. Miller's *North American Geology and Paleontology*, a book too often used as a bibliography only. It also contains some elementary hints on Greek and Latin and a list of older genera (fossils only) with indication of gender.

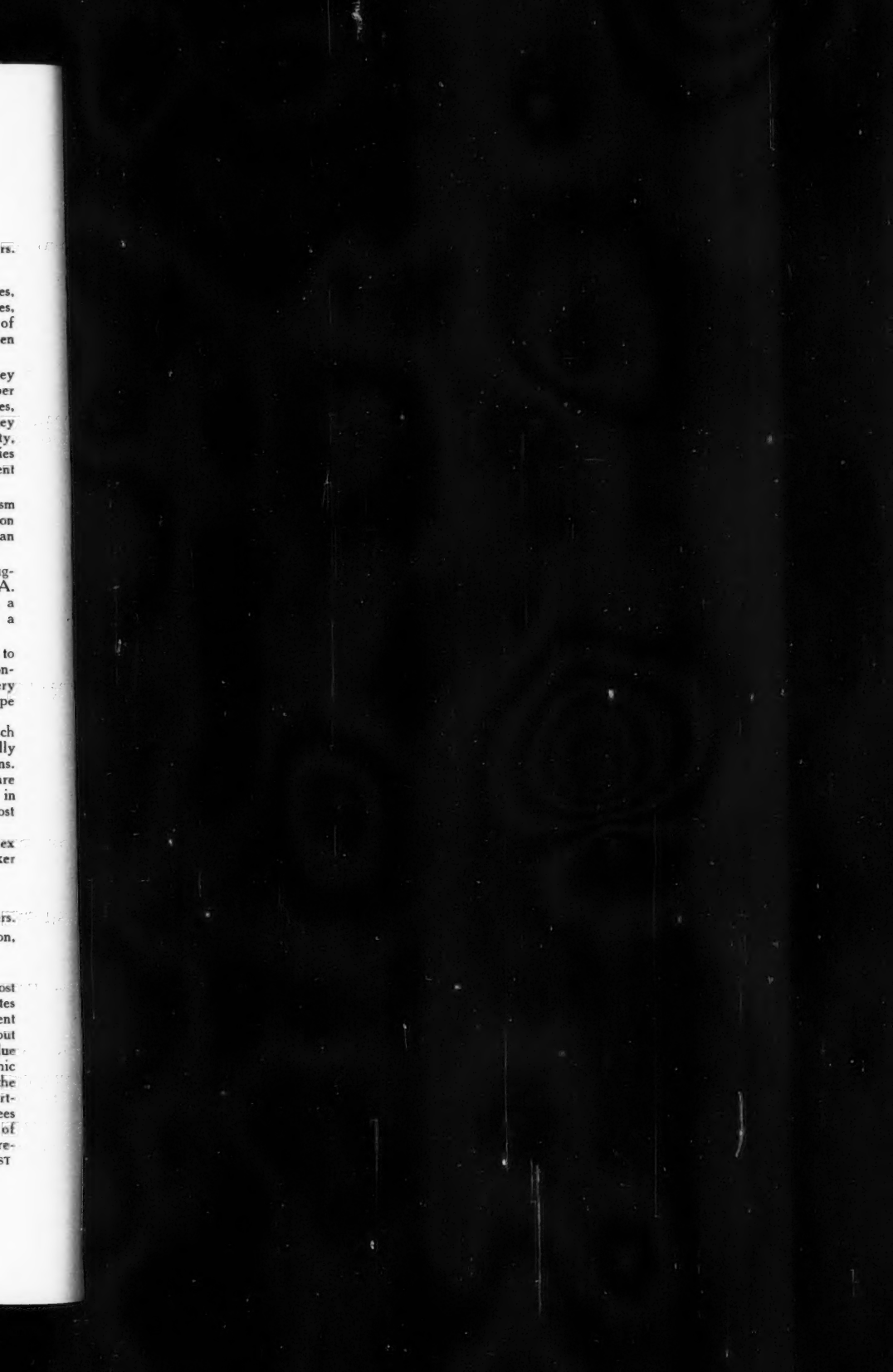
This volume properly frowns upon specific names both "barbaric" and hard to pronounce, giving *ntlakapamuxanus* as an example. It neglects, however, such monstrosities as *scheierbrockhillensis*, *kriegercreekensis* and *helenshoemakerae* which every editor encounters and which often are treasured by their makers merely because type specimens have been catalogued under those names—before publication.

Schenk and McMasters recommend an amount of printed material on plates which seems inconsistent with an octavo page. If explanations face plates, as they generally do, elaborate titles are unnecessary. They also are wasteful in requiring wide margins. Some recommendations as to synonymy seem similarly extravagant, though others are thoroughly sound. Every editor probably wonders why authors who waste space in plate copy commonly telescope their references on synonymy until they are almost useless.

Republication of rules and opinions is given special point by the detailed index accompanying them. It alone makes *Procedure in Taxonomy* essential to the worker in that field. — C. L. FENTON.

TREE FLOWERS OF FOREST, PARK, AND STREET. By Walter E. Rogers. The Drawings from nature by Olga A. Smith. Published by the author; Appleton, Wisconsin, 1935. 500 pp. $7.50.

Nearly 100 trees are illustrated and described in this non-technical study. Almost every species included is figured in its "winter outline" which is followed by silhouettes of buds, leaves, flower clusters and even fruits, plus descriptions as well as excellent plates showing the flowers for most part greatly enlarged. These plates making up about half of the book are the outstanding feature of it both as regards their scientific value in revealing the frequently inconspicuous flowers (20-30x) in detailed photographic close-ups as well as in the aesthetic pleasure they convey to the reader. Thus the author seems to have carried out successfully his double aim, first to show tthe importance of trees in the winter landscape and secondly to illustrate the "flowers" of trees too often overlooked because of their small size. The author's devotion to the study of trees must indeed have been great to undertake so expensive a publication and nature-lovers will be grateful to him for his courage in presenting it to the public.—TH. JUST



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